MAR 19 1929

The Engineer.

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VOL. CXLVII.—No. 3816] LONDON: FRIDAY EVENING, MARCH 1, 1929 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—About 185 TONS of FISH BOLTS with NUTS.
SCHEDULE 2.—92 PAIRS DISC WHEELS and AXLES.
SCHEDULE 3.—29 BROAD-GAUGE LOCOMOTIVES.
26 METRE-GAUGE LOCOMOTIVES.

Tenders due as follows :—
Schedule 1, 8th March, 1929.
Schedule 2, 15th March, 1929.
Schedule 3, 5th April, 1929.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 1151

Civil Service Commission
FORTHCOMING EXAMINATION.
MALE CARTOGRAPHERS in the Hydrographic Department of the Admiralty (19-25, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 23rd May. 1152

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/732.—CIVIL ENGINEER REQUIRED by the GOVERNMENT of CEYLON for appointment as Irrigation Engineer for three years' service and prospect of permanency. Salary £500, rising to £900 a year by annual increments of £40 (£600 a year on attaining 30 years of age). Free quarters and free passages provided. Candidates, 26 to 31 years of age, must have passed examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting from Parts A and B of that examination, and have had at least three years' practical experience on Waterworks, Drainage, or Harbour and Dock Works.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/732. 1135

Safety in Mines Research Board.
The Safety in Mines Research Board invite APPLICATIONS for ONE POST of JUNIOR ENGINEER.

The post, which is a whole-time one and tenable in London, is in connection with research on colliery wire ropes.

Candidates must possess good scientific qualifications, including a University Degree (or its equivalent) in Engineering, and be good draughtsmen. Special knowledge of metallurgy is not required.

Other things being equal, preference will be given to ex-Service men.

The post is graded as a Junior Assistant with a scale of salary of £160 per annum, rising by annual increments of £10 to £190. In addition a variable cost-of-living bonus is payable, making the present minimum of the scale £246.

Forms of application, which must be returned not later than 15th March, can be obtained from the UNDER-SECRETARY FOR MINES, Establishment Branch, Mines Department, Dean Stanley-street, London, S.W. 1. 1136

In the Matter of LETTERS PATENT Granted to HUBERT ELWELL SMITH, dated 1st July, 1913, and Numbered 15,197 of 1913, for the Invention of "Improvements in and Connected with Carburettors."

Notice is Hereby Given that on the 9th April 1929 an ORIGINATING SUMMONS (1929 S. No. 224) issued out of the High Court of Justice (Chancery Division) on behalf of Spensers (London) Limited HUBERT ELWELL SMITH and KENNETH SMITH asking that the term of the Patent may be extended for a further period of four years will come before Mr. Justice Luxmoore for directions as to the hearing and any person desirous of being heard in opposition must at least 7 days before that date leave notice of Opposition (giving an address for service within the United Kingdom) at Room 175 Royal Courts of Justice Strand London and serve a copy thereof upon the undermentioned Solicitors and upon the Solicitor to the Board of Trade.

Dated 25th day of February 1929.
CULROSS & CO.,
13 Old Cavendish-street, London, W. 1.
Upon whom all documents requiring service may be served. 1112

In the High Court of Justice 1928 H. 049.
Chancery Division
Mr. Justice Clauson.
In the Matter of HENRY CRAWSHAY & COMPANY LIMITED and REDUCED,
and
In the Matter of the COMPANIES (CONSOLIDATION) ACT 1908.

Notice is Hereby Given that a PETITION presented to the High Court of Justice on the 25th October 1928 for CONFIRMING the REDUCTION of the CAPITAL of the above Company from £140,000 to £119,000 is directed to be heard before Mr. Justice Clauson on Tuesday the 19th day of March 1929.

Dated the 22nd day of February 1929.
GIBSON & WELDON,
27 Chancery-lane, W.C. 2,
Agents for
WELLINGTON CLIFFORD & MATTHEWS,
Gloucester,
1093 Solicitors for the said Company.

Heriot-Watt College,
EDINBURGH.
PROFESSOR OF MECHANICAL ENGINEERING.
The Governors invite APPLICATION for the PROFESSORSHIP of MECHANICAL ENGINEERING, which will shortly become vacant owing to the retirement of Professor Richard Stanfield, M. Inst. C.E., A.R.S.M.

The Professor is head of the Mechanical Engineering Department, which includes Day Courses of University standard and Evening Courses of study. The person appointed will be required to take up his duties on 1st September, 1929. Salary £1000 by £50 to £1200. Particulars may be obtained from the Principal at the College, to whom applications should be sent by 16th March.

J. CAMERON SMAIL, O.B.E.,
949 Principal.

The Engineer

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PUBLIC NOTICES

City and County of Kingston-upon-Hull.
ELECTRICITY DEPARTMENT.
The Electricity Committee of the above invite TENDERS for :—
ONE TWO MILLION GALLONS PER HOUR ELECTRICALLY DRIVEN CIRCULATING WATER PUMP, MOTOR, MOTOR STARTER, &c.

Tender forms, general conditions, specification and drawings can be obtained upon application to the undersigned on payment of One Guinea for each specification, which amount will be returnable on receipt of a bona fide Tender.

Additional copies may be had at a cost of Ten Shillings each, not returnable.

Cheques and postal orders to be made payable to the City Treasurer, Guildhall, Hull.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders to be addressed to :—
The Chairman, Electricity Committee,
Town Clerk's Office,
Guildhall, Hull,
endorsed "Contract 138," and must be delivered to the above address not later than Noon, Thursday, March 21st, 1929.

J. N. WAITE, M.I.E.E., F.I.F.,
City Electrical Engineer and Manager,
Electricity Works,
Sculcoates-lane, Hull,
February, 1929. 1103

City of Hull.
TO CONSTRUCTIONAL ENGINEERS.
The Tramways Committee of the Hull Corporation invite TENDERS and SCHEMES, including STANCHION FOUNDATIONS, STANCHIONS and ROOFING, for the ERECTION of a MOTOR BUS DEPOT in Barnsley-street.

Site plan and specification to be obtained from the City Architect upon payment of a deposit of Two Guineas, which sum will be returned upon receipt of a bona fide Tender.

Remittances to be made payable to the City Treasurer and Accountant, Hull.

Tenders, drawings and all particulars required in accordance with the specification, are to be sealed, endorsed "Tender for Motor Bus Depot, Barnsley-street," addressed to the Chairman of the Tramways Committee, and are to be delivered at the Town Clerk's Office, Hull, before Ten o'clock a.m. on Monday, 25th March, 1929.

The lowest or any Tender not necessarily accepted.
D. HARVEY, A.R.I.B.A.,
City Architect.
Guildhall, Hull,
January 23rd, 1929. 1096

PUBLIC NOTICES

South Indian Railway Company, Limited.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
1. ROLLED STEEL DISC WHEELS and AXLES (208 PAIRS).
2. STEEL WORK for BRIDGES (Approximately 761 TONS).
3. POINTS and CROSSINGS, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Wheels and Axles," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, 15th March, 1929, in respect of Specification No. 1, and not later than Twelve Noon on Tuesday, 2nd April, 1929, in respect of Specifications Nos. 2 and 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specifications Nos. 1 and 2, and of 10s. for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, Westminster, S.W. 1.
27th February, 1929. 1153

NEW ABATTOIR—STANLEY, LIVERPOOL.
The Corporation of Liverpool invite TENDERS for :—
1. REFRIGERATING PLANT INSTALLATION.
2. INSULATION to COLD STORAGE and CHILL ROOMS.

Forms of Tender, specifications and drawings may be obtained from the Land Steward and Surveyor, Municipal Buildings, Liverpool, on and after Tuesday, 26th instant, on payment to the City Treasurer of the sum of £3 3s. in each case, which amount will be refunded on receipt of a bona fide Tender.

Sealed Tenders, in the official envelope provided, addressed to the undersigned, to be sent in THROUGH THE POST so as to be delivered not later than 10 a.m. on Tuesday, 19th March, 1929.

The Corporation do not bind themselves to accept the lowest or any Tender.

WALTER MOON,
Town Clerk.
Municipal Buildings, Liverpool,
21st February, 1929. 1098

PUBLIC NOTICES

Infringement of Patent.
A CASH REWARD will be paid to anyone GIVING INFORMATION as to the NAME and ADDRESS of the MANUFACTURER or SUPPLIER and the USER of PELTON WATER TURBINES fitted with a DEFLECTOR situated on the axis of the jet and operated by shaft governor, in infringement of my U.K. Patent No. 239,796/1925.—Communications, which will be treated in strict confidence, should be sent to P. PITMAN, M.I. Mech. E., 25, Victoria-street, Westminster, London, S.W. 1. P6580

The Directors of the Egham and Staines Electricity Company, Ltd., are prepared to receive OFFERS for :—
ONE 500 B.H.P. English Electric DIESEL ENGINE direct coupled to ONE 2200-Volt, Single-phase, 50 Cycles ALTERNATOR.
Particulars of the plant from the MANAGER, Electricity Works, Staines. 1087

The Tralee and Fenit Harbour Commissioners invite TENDERS for the PROVISION and ERECTION of COLD STORAGE ACCOMMODATION at Fenit, in accordance with the plans and specifications, copies of which can be had on application to the undersigned.

Sealed Tenders to reach me not later than 14th March, 1929.

The lowest or any Tender not necessarily accepted.
J. LAWLOR,
Secretary.
Harbour Offices, Tralee. 1097

West Bromwich Union,
HALLAM HOUSE, WEST BROMWICH.
The Guardians invite TENDERS for the SUPPLY and INSTALLATION of TURBINE PUMP in accordance with specification and plan prepared by Messrs. Edwards and Shaw, Consulting Engineers, 105, Colmore-row, Birmingham.

Conditions of contract, specification and form of Tender may be obtained at my office, 22, Lombard-street, West Bromwich, from Monday, 4th March, 1929.

Sealed Tenders, endorsed "Tender for Turbine Pump," must be received by me not later than 10 a.m. on Wednesday, 13th March, 1929.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
A. H. WARD,
Clerk.
22, Lombard-street, West Bromwich,
26th February, 1929. 1125

County Borough of Northampton.
TEMPORARY ENGINEERING ASSISTANT.
APPLICATIONS are INVITED from persons who have had practical experience in the Preparation of Schemes for a Main Outfall Sewer, Disposal Works and Pumping Station.

Actual practical experience of this class of work is essential, and applicants should not be under thirty years of age.

The salary will be Seven Guineas per week.

Applications, stating age, experience, date when duties could be commenced, and accompanied by copies only of three recent testimonials, to be sent to the undersigned not later than first post on Friday, the 15th day of March, 1929, endorsed "Temporary Engineering Assistant,"

ALFRED FIDLER, M. Inst. C.E.,
Borough Engineer.
Borough Engineer's Office,
Guildhall, Northampton.
February 28th, 1929. 1147

Metropolitan Water Board.
APPOINTMENT OF TWO MECHANICAL ENGINEERING DRAUGHTSMEN.
The Metropolitan Water Board invite APPLICATIONS for the above-mentioned APPOINTMENTS at a commencing salary of £215 per annum, rising by annual increments of £15 to £260 per annum, plus a fluctuating "cost-of-living" bonus, which on a salary of £215 amounts at the present time to £102 12s. 11d. per annum. The bonus is payable pending further order by the Board.

Candidates should have had workshop and drawing-office experience, preferably in the construction and design of waterworks pumping machinery.

The successful candidates will be required to pass a medical examination and to undertake to contribute to the Board's Superannuation and Provident Fund.

Applications, in candidate's own handwriting, stating age and full particulars of training, experience and qualifications, should be addressed to Mr. Henry E. Stilgoe, M. Inst. C.E., Chief Engineer, and must reach the offices of the Board not later than Monday, 25th March, 1929.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173 Rosebery-avenue, E.C. 1,
23rd February, 1929. 1102

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PUBLIC NOTICES

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

REQUIRED, for service on the Company's Railway in India, ONE ASSISTANT ELECTRICAL ENGINEER.

QUALIFICATIONS.

(1) Age not exceeding 32 years. Good general education, preferably a public school.

(2) Four years' technical course at a University with a Degree in Electrical Engineering.

(3) Not less than three years' workshop training, including electrical test and drawing-office.

(4) Not less than three years' practical experience in oil and steam-operated electric generating undertakings, with experience also in the laying, erection and maintenance of electric cables and aerial lines, the maintenance of transformers and switchgear, and the maintenance of distribution networks.

(5) If possible, experience with a firm of contracting engineers or manufacturing works undertaking complete electric generating and sub-station equipment.

(6) If possible, experience with a firm of consulting engineers.

SALARY.—At age of 32 years, Rs. 675 basic pay plus £25 overseas pay per mensem.

TERMS.—Subject to a strict medical examination by the Company's Consulting Physician, a three years' agreement in the first instance, a first-class free passage to India and home again on satisfactory termination of agreement, which is extensible by mutual consent. Employees are required to subscribe one month's pay yearly to the Company's Provident Fund, and to those of over 5 years' service a bonus equal to their contribution is credited, both bonus and contribution accumulating at compound interest until retirement.

Applications (by letter only), giving full particulars of general and technical education and practical experience in choronological order, stating age, honours gained (if any), whether married or single, together with copies only of testimonials, must be addressed as below not later than Wednesday, 20th March, 1929.

THE SECRETARY,
Madras and Southern Mahratta Railway Co., Ltd.
25, Buckingham Palace-road,
Westminster, S.W. 1.
22nd February, 1929. 1094

Wanted, a Thoroughly Competent and experienced MECHANIC, to Take Charge of and Keep in Repair the Mechanical Plant at this Gasworks. Must possess thorough knowledge of High-speed and Reciprocating Steam Engines and Turbines, Dynamos, Motors, and Electrical Equipment.

Applications, stating age and wages required, to be sent, with copies of testimonials, to

J. W. AUCHTERLONIE,
Engineer and Manager.
Cambridge University and Town Gas Light Company.
Cambridge. 1148

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED in Dorking, for a Period of Six to Eight weeks, possibly longer, the SERVICES of a fully experienced DRAUGHTSMAN, capable under supervision of completing working drawings and general arrangements of Roadmaking Machinery.

Address in the first instance, with particulars of experience and salary required, P5574, The Engineer Office. P5574 A

WANTED by Large Engineering Firm in the Midlands, experienced MACHINE TOOL DESIGNER. State age, experience, salary, and when disengaged.—Address, 1119, The Engineer Office. 1119 A

WANTED, SALESMAN, with Established Connection and good technical knowledge and experience of Compressors and Vacuum Pumps.—Address application, with full particulars of age, experience, and salary required, 1141, The Engineer Office. 1141 A

WANTED, COMPETENT RATE FIXER for Machine Shop; only men conversant with Machining Steel Castings to fine limits for the Commercial Vehicle Industry and experienced regarding cutting feeds and speeds need apply.—Address, giving full particulars of experience, age, and remuneration required, 1052, The Engineer Office. 1052 A

A COMPANY REQUIRES the SERVICES of a thoroughly competent and experienced MECHANICAL ENGINEER to act as Chief Engineer at a Metallurgical and Chemical Works in South Wales. He should have had a thorough grounding in theoretical work, including a good University Degree or its equivalent, and also some years of practical experience. He will be required to undertake a thorough overhaul of the existing Engineering Department organisation (including drawing-office, &c.) and to carry through an important programme of modernisation, re-design extension of plant which the company has under immediate consideration. Age about 35.

Address, giving full particulars of qualifications and salary expected, 1092, The Engineer Office. 1092 A

ASSISTANT PLANT ENGINEER.—Young Capable MAN, with up-to-date experience in modern production methods and in maintenance of plant, REQUIRED by large Firm of Engineers in West London.—Address, stating full details of training and experience, age, &c., 1080, The Engineer Office. 1080 A

ASSISTANT to WORKS MANAGER REQUIRED for an important London Firm of Manufacturers in S.W. 11 district. Previous experience in the rapid production of mouldings from powders under high pressure, small fittings by press tool work, and general mechanical and electrical engineering are advantages. High character, tact and a good education are essential.—Address, stating age (which should be about 26), particulars of training, experience in management, and salary required, 1126, The Engineer Office 1126 A

BOARD MILL CHIEF ENGINEER WANTED. Must have experience in Steam and Electrical Plant, Paper or Board Mill Machinery and General Millwrighting. A progressive man able to effect economies and introduce improvements is required. Good salary and bonus on results.—Address, P5578, The Engineer Office. P5578 A

ENGINEER REQUIRED by Midland Manufacturers, to Take Charge Power Plant comprising Babcock and Lancashire Boilers, Horizontal and Vertical Engines, Fire Pumps, &c. Qualified marine engineer preferred, but not essential.—Address, stating age, experience, and salary required, P5564, The Engineer Office. P5564 A

ENGINEER SALESMAN REQUIRED. Must be well established in Marine and General Engineering Trades. Applications treated in confidence. State experience, age, salary required, &c.—Address, 1144, The Engineer Office. 1144 A

ENGINEER SALESMAN, Age 30-35, REQUIRED for London Office of a Power Transmission Company. First-class experience of Conveyor and Elevating Machinery, also experience as Salesman essential. Only those with the above experience need apply.—Address, giving full details as to experience, education, age, and salary required, 1118, The Engineer Office. 1118 A

ENGINEERS REQUIRED FOR DESIGNING AND ESTIMATING Heavy Duty Cranes and Machinery, Hydraulic Regulating Gates and Movable Bridges. Must have good technical training and experience along these lines, and ability to handle such engineering work to completion on own initiative with capacity for advancement. Not over 35 years of age.

Apply, giving full personal particulars, salary expected, also training and experience, outlining exactly duties performed, to DOMINION BRIDGE COMPANY, Limited, Box 4016, Montreal, Canada. 953 A

PRODUCTION ENGINEER REQUIRED, with expert knowledge of the design of Battery-driven Electric Vehicles and Trucks. When applying give full particulars as to training, with references, age, and salary required.—Address, P5563, The Engineer Office. P5563 A

SITUATIONS OPEN (continued)

INSTRUCTORS (Whole Time) REQUIRED, London area, for General Engineering (workshop machines and precision work), Motor Engineering (workshop), Smithing and Machine Tools, Oxy-acetylene Welding (H.P.), Sheet Metal Work, Cable Splicing and Electric Wiring (aero work). Wages £5 5s. for 44-hour week. Must be good craftsmen, able to teach and maintain discipline. State age and experience with copies of references.—Write to "G. C." c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 1137 A

LARGE LONDON SPECIALITY ENGINEERS REQUIRE IMMEDIATELY an able MANAGING ENGINEER to organise and boss assembly, inspection and test, components requisitioning or buying, spare parts stocking and service of large output of patent intricate industrial machinery. Essentially requires mastery of men, resource, imagination and keen business acumen. No special parts manufacturing technique required. Salary, including bonus, £2000 per annum upwards.—Write, stating qualifications in confidence, Box No. 486, c/o Hooper and Batty, Ltd., 15, Walbrook, E.C. 4. 1099 A

MANAGER.—APPLICATIONS are INVITED for the POST of MANAGER for a Water Gas Lap-welded Steel Pipe and Tank Works. Experience desirable of Electric and Oxy-acetylene Welded and Riveted Steel Tank Work. Applicants must be alert and thoroughly capable of designing and estimating and managing the manufacture with the utmost efficiency on the most modern lines.

All applications will be treated in the strictest confidence and should state full particulars of experience, age, and remuneration desired.

Address, "WELDING," Wm. Porteous and Co., Advertising Agents, Glasgow. P5560 A

MARINE ENGINEER, Single and Not Over 32 years of age, is REQUIRED for a Consulting Engineer's and Marine Surveyors' Office in the East. Applicants must possess First Class B.O.T. Certificate, have some drawing-office experience, with preferably a leaning towards naval architecture. The position offers good prospects to a suitable man. The salary, &c., will depend on the qualifications of the applicant. —Address, 1124, The Engineer Office. 1124 A

PIPE MANUFACTURERS REQUIRE Experienced SALES MANAGER with good connections amongst water engineers, &c. State qualifications, age, experience, and salary required, and send photo. —Address, P5541, The Engineer Office. P5541 A

RATE FIXER and INSPECTOR for Small General Engineers' works in the Midlands, employing about 100 hands, manufacturing Colliery Plant and general machinery. State age, experience and salary required.—Address, 1059, The Engineer Office. 1059 A

REPRESENTATIVE for London is REQUIRED by well-known Manufacturers of Pipe Work, Superheaters, &c. Applicants must be practical engineers, with commercial experience and a good personal connection with steam users. Good salary and commission. Age and experience should be stated.—Address, 1107, The Engineer Office. 1107 A

TECHNICAL PUBLICITY MANAGER. Young, with previous experience of technical journalism and technical advertising, to undertake whole time Publicity Work in connection with Electrical—Hydraulic, Textile, and Fire Engineering productions.—Apply by letter only, in own handwriting, giving full particulars of training, attainments, and experience, also salary required, to "APPOINTMENTS," Mather and Platt, Ltd., Park Works, Manchester. 1060 A

YOUNG ENGINEER, Single, REQUIRED for Nitrate Pampa, Chile. Must have served apprenticeship in locomotive or Diesel engine works, with engineering degree or certificate of technical training.—Address, fully stating qualifications, P5576, The Engineer Office. P5576 A

YOUNG MAN, with Engineering Training and Drawing-office experience. Degree man preferred.—Address, P5559, The Engineer Office. P5559 A

WANTED by West of England Aircraft Firm, ENGINEER DRAUGHTSMAN, capable translating technical French and German.—Address, 1105, The Engineer Office. 1105 A

WANTED, DRAUGHTSMAN, Accustomed to Internal Combustion Engineering; preference for those who have had railway experience or lorry.—Address, stating full experience and salary required, 1127, The Engineer Office. 1127 A

DRAUGHTSMAN ESTIMATOR (Assistant) REQUIRED for the Heating and Ventilating Dept. of BENHAM and SONS, Ltd., 66, Wigmore-street, W.1. —Apply by letter, stating age, salary, and experience. 1128 A

DRAUGHTSMAN, Expert Designer of Light Steel-framed Buildings, for London office.—Write, stating age, experience, salary required, and when free, to A. and J. MAIN and CO., Ltd., Australia House, Strand, London. Applications will be treated in strict confidence. 1101 A

DRAUGHTSMAN for Heavy Oil Engines, Land Type. —Address full particulars, age, and salary required, 858, The Engineer Office. 858 A

DRAUGHTSMAN (Not Junior) for Pumping Machinery, Reciprocating and/or Centrifugal.—Address, stating age, experience, salary required, 857, The Engineer Office. 857 A

DRAUGHTSMAN, Permanent Position and Prospect of advancement offered to a quick and accurate draughtsman, S.W. London. State age, experience, and salary required.—Address, P5561, The Engineer Office. P5561 A

DRAUGHTSMAN.—REQUIRED, in London Office of Firm of Engineers, DRAUGHTSMAN with knowledge of Conveying and Mechanical Handling Plants. Experienced men only need apply. State age, experience, and salary required.—Address, 1073, The Engineer Office. 1073 A

DRAUGHTSMAN REQUIRED for Packing and Labelling Machinery. ENGINEER SALESMAN also REQUIRED, connection manufacturing confectioners preferable. Works situated at Wembley. State age, experience, and salary required to "WEMBLEY," c/o Dixon's, 195, Oxford-street, W. 1. P5558 A

DRAUGHTSMAN WANTED. Must be Fully Experienced in up-to-date Power Station Condensing Plant.—Apply, giving past experience, salary required, age, &c., to W. H. ALLEN SONS and CO., Ltd., Queen's Engineering Works, Bedford. 1117 A

DRAUGHTSMAN, Age 25-30, Experienced in Theory and design of Machine Tools or similar work. Good prospects. State experience and salary.—Address, 1120, The Engineer Office. 1120 A

ENGINEER DRAUGHTSMAN, Man with General Practice and Design. Quick, accurate, and dependable. —Address, stating age, experience, and salary required, 1121, The Engineer Office. 1121 A

EXPERIENCED DRAUGHTSMAN WANTED for the Mid-East, with sound knowledge of Structural Work, Building, Reinforced Concrete and Estimating. Age 26 to 30, single. Please state salary required for a four years' agreement. Also send copies of testimonials only.—Address, P5557, The Engineer Office. P5557 A

MACHINE TOOL DRAUGHTSMAN REQUIRED for intermediate work.—Address, giving full particulars, age, and salary required, 1114, The Engineer Office. 1114 A

SITUATIONS OPEN (continued)

TRACTION CONTROL GEAR DRAUGHTSMEN REQUIRED, age 25 or over. Only experienced men need apply. State age, experience, and salary required.—Address, 1116, The Engineer Office. 1116 A

TWO DRAUGHTSMEN REQUIRED for the Design of Oil Circuit Breakers. Preference will be given to those who have had some experience on Super High-tension Breakers.—Apply, stating age, experience, and salary required, GENERAL ELECTRIC CO., Witton, Birmingham. 1108 A

SEVERAL DRAUGHTSMEN REQUIRED for the Layout of H.T. and E.H.T. Switchgear.—Apply, stating age, experience, and salary required, GENERAL ELECTRIC CO., Witton, Birmingham. 1109 A

WANTED, Good POWER STATION FITTER. Preference given to one with experience on Ruston and Hornsby Oil Engines.—Apply, stating age, experience, and wages required, to RESIDENT ENGINEER, Silver End Development Co., Ltd., Silver End, Witham, Essex. 1093 A

FIRST-CLASS BOILERMAKER REQUIRED for Erection Work on Open-cast Mine in Gold Coast Colony. Man aged 25/35, with previous experience on the Gold Coast preferred. Wages 25s. per shift; 12 months' tours with free second-class passages out and home.—Write, stating age, full particulars of experience, and with copies of testimonials, to D.C., c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 1113 A

SITUATIONS WANTED

COMPETENT EXECUTIVE. Experienced in the organisation and establishment of engineering industries and works on efficient production basis, DESIRES advantageous OPENING; exceptional record.—Address, P5579, The Engineer Office. P5579 B

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Pulverised Fuel for Cargo Steamers.

THE announcement is made that one of the new 9000 tons deadweight carrying capacity cargo steamers, which are being built by W. Gray and Co., Ltd., at West Hartlepool, for Sir R. Ropner and Co., Ltd., will be equipped for burning powdered coal, the complete installation of crushers, pulverisers and burners being supplied and fitted by the Brand Powdered Fuel System, Ltd., of London. The bunkers in the ship will be designed to trim through a coal crusher to the pulveriser, which will deliver the powdered fuel to a ready-use bin from which the nine furnaces of the three boilers will be fed. Tests are being carried out at the company's Barnsley works on a new type of burner with a short pre-furnace, specially adapted for use with Scotch marine boilers. The new ship will, when completed, be engaged in time charter business, and opportunity will be presented to carry out tests under widely differing service conditions and with various types of fuel. It is understood that the Brand Company has been able to offer the owners a definite guarantee with respect to the efficiency of the boilers, and that instead of requiring about 32 tons of raw coal per day, only 28 tons will be needed when burning pulverised fuel. According to news recently received from New Zealand, the New Zealand Shipping Company's steamer "Hororata," half the boilers of which are equipped with the Howden-Buell system of burning powdered coal, is giving every satisfaction. There is stated to be a saving of two or three tons of coal in the daily consumption, and very even firing is obtained with varying qualities of coal. There is very little smoke, while the furnaces require less cleaning than with ordinary hand firing. A description of the equipment on the "Hororata" was given in THE ENGINEER for December 14th last. The Blue Star Line announces that as a result of the experiments made in its liner Stuartstar, it has decided to complete the Woodeson pulverised fuel installation on this ship and to fit similar equipment on all its fleet of cargo steamers.

A Suggested Iron and Steel Trades Inquiry.

PUBLICATION has now been made of the Prime Minister's reply, dated February 8th, to the letter sent to him on December 31st by the General Secretary of the Iron and Steel Trades Confederation, dealing with the adverse conditions that have prevailed during the past seven years in the iron and steel industry, particularly in the heavy sections. It will be recalled that the Confederation suggested that a Royal Commission or other competent Committee should be appointed to make a full and impartial study of all the facts concerning the present position of the industry. Mr. Baldwin, in his reply, stated that the suggested Royal Commission was, in his view, unnecessary either as a preliminary to effective action or as a means of obtaining information not otherwise available. He pointed out that the Committee on Industry and Trade, under the chairmanship of Sir Arthur Balfour, had already presented a detailed report on the iron and steel industry. A fresh inquiry would simply cover the same ground. He also stated that if his Government were returned to power it was intended that the iron and steel industry should be allowed to make an application under the Safeguarding of Industries procedure, and that it would then have an opportunity of stating its case before an independent tribunal. Mr. Pugh, the Confederation's Secretary, has replied to the Prime Minister's letter and has expressed his Executive Council's regret that the policy disclosed by Mr. Baldwin does not, in its opinion, ensure that the conditions of the iron and steel industry will be treated in an atmosphere free from political prejudice.

High-speed Atlantic Liners.

THE conditions under which the sale of the United States Lines to P. W. Chapman and Co. has been effected promise to introduce a new factor into the impending Atlantic speed competition. According to present indications, the next few years will witness the entry into service of a whole fleet of liners, each surpassing in speed the swiftest vessels now afloat. Two or three months hence the Norddeutscher-Lloyd vessels "Europa" and "Bremen," of 46,000 tons and 26½ knots, should be ready for their maiden voyages. The 60,000-ton White Star liner now being built at Belfast is credibly reported to be designed for a speed not inferior to that of the German vessels. The Cunard Line is understood to be on the point of ordering a "super-Mauretania" of phenomenal tonnage and speed. The Cie. Générale Transatlantique is reported to have ordered from the Penhoët yard at St. Nazaire a 60,000-ton ship of 27 knots, while contracts are about to be placed in Italy by the Navigazione Generale Italiana and the Lloyd Sabaudo for two ships of 40,000 and 50,000 tons and 27 knots. Finally, the purchasers of the United States Lines announce their intention of building two ships superior in speed to the "Leviathan," and New York reports indicate that these vessels will be of at least 50,000 tons each, with a contract speed of 27 knots. Should all these plans materialise, as there seems no reason to doubt, the Transatlantic liner service will in a few years from now be reinforced by no less than nine vessels, all of which will be larger and faster than the "Mauretania," at present the fastest liner in the world. Never before has international rivalry in the sphere of rapid ocean transit been so pronounced as it is to-day. The prospect is a fascinating one, alike from the professional and the popular point of view.

Advertising British Goods Abroad.

A LETTER has been sent to the Prime Minister by Mr. Percy Lister, managing director of R. A. Lister and Co., Ltd., engineers, Dursley, Gloucestershire, in which it is urged that a million pound fund should be created for the purpose of advertising British goods abroad. Mr. Lister suggests that the proposed National Advertising Fund should be controlled by a committee of experts representing industry and appointed by the Government. If ninety-nine other firms will do likewise his firm is prepared, he states, to contribute a sum of £5000 to the fund, and he suggests that for every pound so subscribed the National Exchequer should contribute an equal amount. Some individual firms and industrial associations, he states, already advertise widely in the overseas as well as in the home market, but he holds that far more is needed for success. A campaign of corporate advertising by British industry as a whole would, he is persuaded, be of the greatest possible value in bringing the name of Great Britain and her products before the enormous potential markets that exist in every continent. Mr. Lister is strongly of the opinion that the attention of British industry should be directed to the scheme before the thoughts of the country are turned away from industry by the turmoil of the General Election.

The German Armoured Ship.

OUR Berlin contemporary *Schiffbau* gives some further details of the German armoured ship "Ersatz Preussen," a description of which appeared in our issue of January 11th. The vessel is to be driven by internal combustion engines of 50,000 brake horse-power, which are being built at the M.A.N. works. They will operate twin screws through reduction gearing supplied by the Vulcan Yard, Hamburg, the revolutions between motor and propeller being reduced in the ratio of 9 to 5. The net weight of the motors is hardly more than 8 kilos.—17·64 lb.—per brake horse-power. Although the total weight of the entire plant, comprising motors, gearing, shafting, propellers, accessories, &c., will naturally work out at a higher figure per unit of power, it will still be less than that of a modern geared turbine installation of equal capacity. *Schiffbau* recalls the interesting fact that almost twenty years ago the German Admiralty decided to utilise the undoubted advantages of the internal combustion engine for naval purposes. The M.A.N. firm and the Krupp Germania shops at Kiel were each entrusted with the building of a six-cylinder 12,000 brake horse-power engine, designed to drive the middle propeller shaft of future battleships. These motors weighed more than coeval steam turbine engines, but this drawback was held to be compensated by the saving in fuel consumption. Although they were completed and proved successful, the war prevented their installation afloat. As they weighed 50 kilos.—110·23 lb.—per brake horse-power, the advance represented by the engines of the "Ersatz Preussen" is self-evident.

Industrial Peace.

WHEN the Federation of British Industries and the National Confederation of Employers' Organisations found it impossible to accept the scheme for the establishment of a National Industrial Council as proposed in the Melchett-Turner report of July 4th, they intimated that they were nevertheless conscious of the importance of doing everything in their power to promote peace in British industry. They therefore extended to the General Council of the Trades Union Congress a cordial invitation to send representatives to take part in a discussion designed to help forward a better mutual understanding in industry generally. On Tuesday the General Council of the T. U.C. decided to accept the invitation extended to it by the Federation and Confederation. No date has as yet been fixed for the conference. The occasion will be the first on which bodies representing directly and officially the great organisations of employers and trade unions have met to consult together upon methods of common interest to British industry.

The New Orient Liner "Orontes."

ON Tuesday last, February 26th, there was launched from the Barrow yard of Vickers-Armstrongs, Ltd., the new 20,000 gross tons passenger liner "Orontes," which is being constructed for the Australian mail and passenger service and the cruising service of the Orient Steam Navigation Company, Ltd. The naming ceremony was gracefully performed by Lady Anderson, the wife of Sir Alan G. Anderson, K.B.E., the chairman of the Orient Line. The new steamer is the fourth of its type, and is designed to carry about 500 first-class passengers and 1100 third-class passengers, which, with the officers and crew, make a ship's complement of over 2000 persons. The "Orontes" has an overall length of 664ft. with a beam of 75ft. and a depth moulded to deck of 47ft. The twin-screw single-reduction geared turbine machinery of the latest Parsons type is designed for a total output of 20,000 S.H.P., corresponding to a ship's speed of 20 knots. High-pressure and low-pressure astern turbines with 75 per cent. of the ahead power are incorporated in the intermediate and low-pressure casings of the main turbines. Steam at a working pressure of 215 lb. per square inch will be supplied from six double-ended and two single-ended boilers arranged for oil burning under Howden's forced draught system. All the boilers are 16ft. 6in. in diameter and the length of each double-ended boiler is 21ft. 9in., while that of the single-ended boilers is 11ft. 2in. The deck auxiliaries, the ventilating fans and most of the engine-room pumps are to be electrically operated. To provide the necessary current for power and lighting there are three steam turbine-driven 220-volt generator sets, each designed for an output of 400 kW. An emergency generator set of 36 kW output is also to be fitted. The design of the ship is generally similar to that of the sister ships "Orama," "Oronsay," "Otranto," and "Orford," but several improvements based on the experience gained with these liners have been incorporated.

Engineers' Wages.

FOLLOWING the failure last year of the forty-odd trade unions connected with the engineering industry to obtain a national increase in wages, a special committee was appointed to consider the various sections of the engineering industry separately. The committee came to the conclusion that substantial dividends were being paid in some important sections of the industry, but in its report made no definite recommendation as to the policy which should be pursued. The report was considered at a national executive conference held in London last Friday. The conference discussed whether another national meeting with the employers should be sought or whether a new policy of seeking increases in the more prosperous sections of the industry should be followed. There was considerable discussion on the subject, but after a sitting lasting three hours the report was referred to the executives of the various unions for their consideration, and the conference was adjourned to a date to be fixed in May.

Sir Alexander Kennedy.

THE President of the Royal Society, the Presidents of the Institutions of Civil, Mechanical, and Electrical Engineers, and the Provost of University College have just issued a letter inviting subscriptions for a permanent and lasting memorial of affection and esteem for the late Sir Alexander Kennedy. Sir Alexander was a pioneer in engineering education, for, during his tenure of the Chair of Mechanical and Civil Engineering (1874–1889) at University College, London, he was largely responsible for the lines and methods which higher education in engineering has adopted. As an engineer in practice, his wide knowledge of mechanical and electrical engineering was always available for the service of the country. In connection with the centenary celebrations of University College a movement was inaugurated to endow the department over which he long presided with such distinction; and some time ago he had consented to the Chair in the Department being called by his name. Towards the sum of £30,000 required for this endowment a sum of £18,035 has already been subscribed, leaving the amount of £11,965 still to be raised.

The Melchett-Turner Scheme.

THE British Engineers' Association has issued a reply to the severe criticism of its recent comments on the Melchett-Turner scheme. After pointing out that its conclusions are the same in the main as those of the F.B.I. and the National Confederation of Employers' Organisations, it states that it never demanded, as had been alleged, that members of the General Council of the T.U.C. should renounce their political beliefs before entering the Conference, and goes on to say that "the main functions of the proposed National Industrial Council being consultation and investigation, it follows that the members of the Council should approach their responsible duties with an open mind and perform them in a national and scientific spirit, of which the party political spirit is the very negation." Touching upon the question of the fitness of employers to serve upon the Conference, the B.E.A. says: "The employer, in his own proper and most effective field of action, has so many demands on his time and energy that he cannot be expected to cope unaided with a full-time trades union specialist," and concludes by asserting that it had not "shut the door" and "has no objection to conferences of a constructive and non-political character."

The London Power Company.

No. III.*

The Grove-road Station.

Before the formation of the London Power Company the Grove-road station belonged to the Central Electric Company. This company was noteworthy as being, in a sense, the prototype of the much larger organisation in which it is now merged. It was formed jointly by two of the London electricity undertakings, namely, the St. James and Pall Mall and the Westminster Companies, and in addition to the supply to these companies gave supplies to the Chelsea Company in 1922, the Kensington Company and the St. Marylebone Borough Council in 1924, and to the Metropolitan E.S. Company in 1925, with the object of supplying them with power more cheaply than they could generate it in their separate smaller plants. The Grove-road station was built in 1902. The station is situated in St. Marylebone, on the west side of Regent's Park, and alongside the Regent Canal. The canal serves as a means of transport for part of the coal consumed, but its capacity is far too small to be of much use for condensing purposes. The first equipment of the station consisted of reciprocating engines, when the defects of the site in the matter of cooling water was not of first importance, but as the plant extended and turbo-machinery supplanted the engines, the new conditions were met by the provision of cooling towers. It was fortunate, in many respects that the bulk of the load was a residential lighting load, comparatively small in the summer when the cooling water question was most acute and reaching its maximum in the winter months when the towers operated at their best. Grove-road is now a typical cooling-tower station, its condensers being served by nineteen towers capable of dealing with about 7,000,000 gallons of water per hour.

Grove-road has the credit of being the most efficient of all the stations taken over by the London Power Company. It has indeed been pre-eminent among all the London stations for a good many years. During the year 1927 it delivered to the feeders 164,681,770 kWh, with an overall thermal efficiency of 18·00 per cent. on the higher calorific value of the coal, or 18·97 per cent., if the calculation is based on units generated. Considering that it is a cooling tower station, with a load factor of not much more than 20 per cent., and with steam at a very low pressure and temperature, such a result is undoubtedly creditable. The station certainly possesses some very efficient generating machinery, but as in practically all cases when the performance of a plant is either better or worse than the average, the reason is to be found in the management of the boiler-house. Boiler-house management has for long been a speciality of Grove-road. The consequence is that a boiler-house efficiency of over 80 per cent. is the rule, this being maintained for weeks or months on end. We propose, therefore, to deal very cursorily with engine-room matters at this station, reserving our space for a somewhat detailed account of the boiler plant and its performance.

The Grove-road station, having grown up from small beginnings, has not the symmetry of arrangement possible in a plant designed all at one time. There are, as will be seen in Fig. 9, three boiler-houses, flanked by a long and irregularly-shaped engine-room, also in three parts, the whole bearing witness to the series of extensions which the plant has undergone.

Table VI.—*Leading Particulars of Boilers at Grove-road.*

Reference numbers of boilers—see Fig. 9	22 to 25 inc.	26 to 31 inc.
Maker of boiler	Babcock and Wilcox	Babcock and Wilcox
Type	C.T.M.	C.T.M.
Normal evaporative capacity, lb. per hour	60,000	75,000
Steam pressure, lb. per sq. in.	210	210
Steam temperature, deg. Fah.	675	677
Boiler heating surface, sq. ft.	8,619	10,028
Superheater surface, sq. ft.	3,190	5,068
Green's tri-tube economiser surface, sq. ft.	4,620	6,552
Usco air heater surface, sq. ft.	9,020	16,600
Furnace volume, cu. ft.	2,400	4,100
Diameter of Boiler Tubes, in.	4	4
Number of sections in width of boiler	42	45
Number of tubes per section	11	11
Diameter of superheater tubes, in.	1·5	1·5
Number of coneomiser tubes	330	390
Number of grates	3	2
Grate area, sq. ft.	312	340 and 360

Note.—The three grates fitted to each of the 60,000 lb. boilers are of the Underfeed Stoker Company's type "A." Of the 75,000 lb boilers, Nos 27 and 28 have a pair of type "A" grates, with a combined area of 340 square feet, Nos. 30 and 31 have each a pair of similar grates with a combined area of 360 square feet, and the remaining two, namely, Nos. 26 and 29, are each fitted with a pair of Babcock and Wilcox compartment type chain grates, having an aggregate area of 360 square feet.

The aggregate capacity of the generating plant is 113,000 kW at maximum continuous rating. There are eight turbo-generators, all of the British Thomson-Houston Company's construction. Two of these are rated at 7000 kW each, two at 12,000 kW, and four at 18,750 kW capacity each. All machines generate three-phase, fifty cycle current at 6600 volts. The several boiler-houses contain in all twenty-one boilers, with an aggregate normal evaporative capacity of 1,130,000 lb. of steam per hour, at a pressure of 675 deg. Fah.

* No. II. appeared February 22nd.

The central and oldest boiler-house contains seven boilers, four of the Babcock and Wilcox longitudinal drum type rated at 30,000 lb. per hour, and three of the Woodeson pattern rated at 40,000 lb. per hour each. The east boiler-house has four 50,000 lb. and four 60,000 lb. boilers, while the west boiler-house has six units, all of 75,000 lb. capacity. In these two boiler-houses all boilers are of the Babcock and Wilcox C.T.M. design. Every boiler has its own economiser and superheater, while the ten largest are also equipped with air heaters, raising the temperature of the combustion air to about 250 deg. Fah.

It will be noted that, disregarding differences of type, the twenty-one boilers constituting the complete plant, may be divided into five groups, according to their rated capacities. During the year 1927, of the 127,815 tons of coal consumed in the station, no less than 115,685 tons, or 90·5 per cent. of the total, was burned under the ten largest boilers. To these, therefore, falls the lion's share of the boiler-house load, so that we may regard them as typical of the steam producing units. The leading particulars of the boilers in question are given in Table VI.

The principal figures relating to the performance of the station are given in Table VII.:—

Table VII.—*Operating Particulars of Grove-road Station for Year ending December 31st, 1927.*

Power sold during 1927, kWh	164,681,770
Load factor of station, per cent.	24·38
Percentage of power used on works to total generated	5·16
Weight of coal consumed, tons	127,815
Average higher calorific value as fired, B.Th.U. per lb.	10,900
Average percentage of slack in fuel	49·5
Average percentage of ash by analysis	12·95
Average percentage of refuse to coal fired	14·07
Coal burnt per unit generated, lb.	1·65
Coal burnt per unit delivered to feeders, lb.	1·74
B.Th.U. in fuel per unit delivered	18,960
Overall efficiency of station (on units generated), per cent.	18·97
Overall efficiency of station (or units delivered), per cent.	18·00
Boiler efficiency, per cent.	79·50
Boiler efficiency, less coal used for banking, per cent.	82·64
Percentage of banking coal to total coal	3·69
Boiler load factor, per cent.	78·89
Steam used per kWh delivered to feeders, lb.	12·45
Steam used per kWh generated, lb.	11·80
Steam used by main turbines per kWh generated, lb.	11·08
Turbine efficiency, per cent.	69·56
Percentage of make-up water	3·23
Average vacuum for gear, in. Hg. bar. = 30	28·61
Maximum weekly average vacuum, in. Hg., bar. = 30	28·87
Minimum weekly average vacuum, in. Hg., bar. = 30	28·20
Average temperature circulating water inlet, deg. Fah.	65·42
Maximum temperature, circulating water inlet, deg. Fah. (September)	73·00
Minimum temperature circulating water inlet, deg. Fah. (December)	57·00
Average CO_2 at bolier outlet, per cent.	10·51
Average feed temperature to economisers, deg. Fah.	161·0
Average feed temperature to boilers, deg. Fah.	260·0
Average gas temperature leaving boilers, deg. Fah.	542·0
Average gas temperature leaving economisers, deg. Fah.	366·0
Average final gas temperature to stacks, deg. Fah.	258·0
Average air temperature entering heaters (60,000 lb. boilers), deg. Fah.	125·0
Average air temperature leaving heaters (60,000 lb. boilers), deg. Fah.	237·0
Average gas temperature entering heaters (60,000 lb. boilers), deg. Fah.	399·0
Average gas temperature leaving heaters (60,000 lb. boilers), deg. Fah.	304·0
Average air temperature entering heaters (75,000 lb. boilers), deg. Fah.	101·0
Average air temperature leaving heaters (75,000 lb. boilers), deg. Fah.	251·0
Average gas temperature entering heaters (75,000 lb. boilers), deg. Fah.	349·0
Average gas temperature leaving heaters (75,000 lb. boilers), deg. Fah.	219·0
Average steam temperature at boiler stop valve, deg. Fah.	658·0
Average steam temperature at turbine stop valve, deg. Fah.	650·0

The figures are well worth study as an example of what can be done by good operation under conditions which are by no means ideal. Not only has the station inherited a steam pressure and temperature much below what modern practice would require, but it has also to contend with disadvantages peculiar to its position. Supplying, as it does, a predominantly lighting load, its load factor is low, and being situated in London it has to be ready to cope with the sudden demands for current occasioned by the fogs to which the Metropolis is liable during several months of the year. A station with a heavy industrial load during the hours of normal daylight would not have its routine seriously disturbed by a fog, but Grove-road has frequently known its load rise from 20,000 kW to 40,000 kW in ten minutes and must always be operated in such a way as to be able to adjust itself to such emergencies. The efficiencies of both engine-room and boiler-room suffer from so much "standing-by" and a number of boilers remain always banked ready to be put on the line at a few minutes' notice. So important a feature of the operating conditions is the "standing-by" that a distinction is made between the coal burnt for banking purposes and that actually used in making steam. The figures are obtained by reading the coal scales whenever a boiler is put on the line and taken off. During 1927 the coal burnt for banking amounted to 3·69 per cent. of the total consumption, and if this is deducted the boiler-house efficiency for the year works out to the extremely good figure of 82·64 per cent. Without making any allowance for banking, the efficiency is 79·50 per cent., a figure which would be considered hardly attainable in many boiler-houses with none of the drawbacks to which Grove-road is subject.

The overall efficiency of the station, as a whole, namely, 18·00 per cent., based on units actually delivered to the feeders, is again a fine performance, for this figure is not only affected by the conditions in the boiler-room, but also by the situation of the station in respect of circulating water. The whole of the heat rejected to the condensers has to be dissipated by cooling towers, of which there are altogether nineteen, capable in the aggregate of dealing with 72,500,000 lb. of circulating water per hour. Even with this equipment the mean temperature of the circulating water entering the condensers could not be kept below 65·42 deg. Fah. for the year, with the result that no higher average vacuum than 28·61in. of mercury could be carried. During the week ending September 7th the circulating water reached a temperature of 73 deg. at the condenser inlets and it never dropped below 57 deg. Fah. even in the depth of winter. Taken as a week's average, the vacuum fluctuated between 28·87in. as a maximum and 28·20in. as a minimum during the year. Compared with most modern stations, therefore, Grove-road is under a considerable handicap with respect to condensing facilities, a handicap which makes itself felt not only in the steam consumption of the turbines, but in the power required to pump the water over the cooling towers. It is this last factor which accounts largely for the consumption of 5·16 per cent. of the kilowatt-hours generated to supply the needs of the station itself. It is interesting to note that during the year 1927 the amount of water required to make up the losses by evaporation and spray from the cool-

Table VIII.—*Heat Balance, Grove-road, Week Ending April 18th, 1928.*

	B.Th.U.	%	B.Th.U.	%
Moisture loss	137	1·27		
Hydrogen loss	521	4·84		
Dry flue gas loss	801	7·45		
Ash, radiation and unaccounted for	399	3·71		
Returned by air heater			525	4·88
Banking coal loss	337	3·14		
Blow-down loss	21	·19		
Steam leakage loss	120	1·12		
Steam range loss	78	·72		
Circulating pumps, heat lost and work done	157	1·46		
Feed and auxiliary pumps, heat lost and work done	30	·27		
Turbine and generator losses	131	1·22		
Circulating water loss	5,780	53·80		
Returned by circulating pumps			8	·06
Returned by feed and auxiliary pumps			169	1·57
Returned by condensate			319	2·97
Returned by bleeding steam			433	4·03
			929	8·63
Output to switchboard	2,105	19·59		
Unaccounted for	133	1·22		
Heat in 1 lb. of coal	10,750	100·00		

Table IX.—*Grove-road Station.—Heat Account for Week Ending April 18th, 1928.*

	Lb.	B.Th.U.
B.Th.U. at inlet of boilers—		
From coal	7,268,800	78,139,600,000
From feed water	51,131,600	6,289,186,800
		84,428,786,800
B.Th.U. leaving boilers—		
Steam	51,131,600	69,385,581,200
In ash, chimneys, radiation, &c.		15,043,205,600
		84,428,786,800
Steam main—		
Steam to main turbines	48,294,300	65,052,422,100
Steam to circulating pump turbines	892,400	1,202,062,800
Steam to feed and condensing pumps	1,068,600	1,439,404,200
Heat lost in pipe friction, drains, blow-down, leakages, &c.	876,300	1,691,692,100
	51,131,600	69,385,581,200
Main turbines—		
B.Th.U. to condensers		46,265,939,400
B.Th.U. to switchboard		15,269,734,320
Condensate		2,559,597,900
Heat lost in turbine, &c.		957,150,480
		65,052,422,100
Feed and condenser pumps—		
Exhaust to hotwell		1,235,301,600
Heat lost and work done		204,102,600
		1,439,404,200
Circulating pump turbine—		
B.Th.U. to hotwell		60,683,200
Heat lost and work done		1,141,379,600
		1,202,062,800
B.Th.U. returned to hotwell—		
From main turbine condensate		2,559,597,900
From bleeding main turbines		2,897,658,000
From circulating pump turbine		60,683,200
From feed pumps		1,235,301,600
		6,753,240,700
B.Th.U. returned to boilers—		
From hotwell		6,753,240,700
From make-up		21,438,000
		6,774,678,700
Heat lost in friction, leakages, &c.		485,491,900
		6,289,186,800

Average temperature returned to hotwell (assumed), 145 deg. F.
Average temperature make-up water (assumed), 50 deg. F.
Average feed water temperature, 155 deg. F.

ing towers and to replace that run away to reduce the density amounted to 1,287,949,900 lb., or about 7·42 lb. per unit generated. This water is taken partly from wells and partly from the Regent's Canal. The average hardness of the well water is 6 deg. and that of the canal water 18·6 deg. The limit of density which the water in the cooling tower ponds is allowed to attain is about 12 deg., any greater density giving rise to trouble with the condensers.

The heat distribution of the Grove-road station for the week ending April 18th, 1928, is shown graphically by the Sankey diagram Fig. 10, and numerically in somewhat more explicit form in Table VIII. It will be observed that 19·59 per cent. of the heat of the coal reaches the switchboard in the form of electrical energy. The air heaters return to the system nearly 5 per cent. of the heat in the fuel, while a further 8·63 per cent. is returned by way of the hotwell. Table IX. gives the total quantities of fuel water and

The tests relating to each class of coal are compared with the average of the five preceding tests of that coal, in order that any departure from the standard quality may be fairly brought to light. These tests are not relied on as a basis for the calculation of the thermal efficiency of the plant week by week, because the fuel burnt during any short period may have, of course, a very different calorific value from that delivered to the station during the same time. They are used, however, as a check, the mean calorific value for any week being computed from the quantities and qualities burnt and compared with the value found by direct tests of the coal as fired. It is on these latter tests that all computations of thermal efficiency are based. The samples required for such tests are taken in the following manner. Once every hour about 5 lb. of coal are taken from the stoker hoppers of each working boiler and placed in an air-tight bin. Once per day the total quantity thus collected is mixed

During the year 1927, 369 samples of coal were tested, comprising 104 weekly boiler-house samples, 200 samples from truck and barge, 60 samples taken in connection with special boiler trials, and 5 samples obtained from outside sources. In addition to these tests two samples of riddlings were tested, 54 samples of ash, and 1 sample of chimney grit. The combustible matter in the ash was found to range from 9 to 12 per cent. The calorific value of the grit caught by the Davidson dust collectors amounted to 2000 B.Th.U. per pound, and the quantity of grit caught by these devices was no less than 0·6 per cent. of the total weight of coal fired. The higher calorific value of the coal fired, given in Table VII. as 10,900 B.Th.U. per pound, is the average of fifty-two weekly samples taken as described above. The average of fifty-two weekly check tests was 10,960 B.Th.U., and that of fifty-two weekly values, computed from the consign-

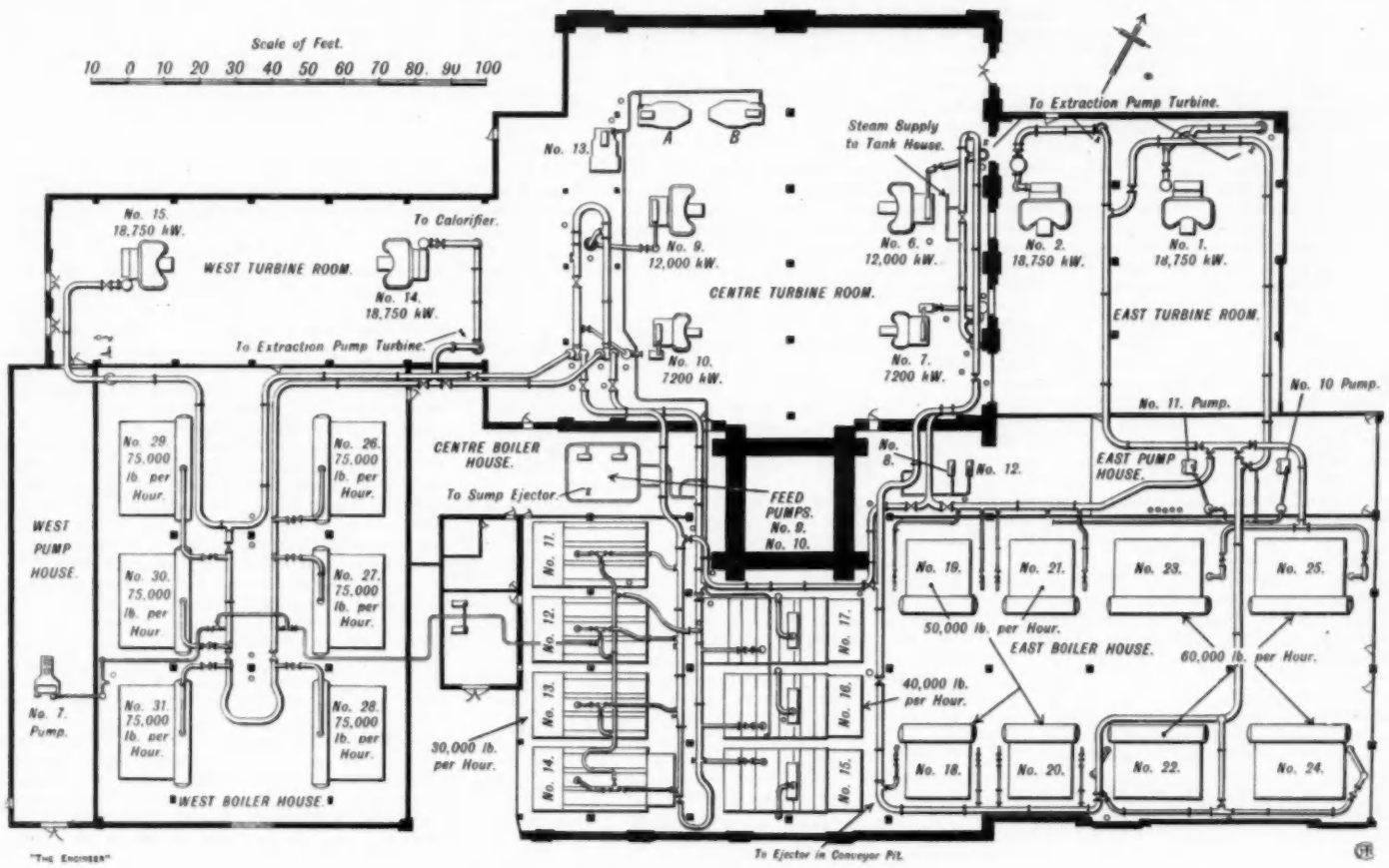

FIG. 9—GROVE-ROAD POWER STATION—GENERAL PLAN

heat concerned in the various operations of the station for the week in question, and the main items are presented in the form of a balance sheet in Table X.

TABLE X.—*Grove-road Station.—Heat Balance for Week Ending April 18th*, 1928.

Input.		B.Th.U.
By coal		78,139,600,000
By returned heat in feed		6,289,186,800
		84,428,786,800
Output.	**B.Th.U.**	**B.Th.U.**
Boilers—		
Chimney, radiation, ash, &c.		15,043,205,600
Steam main—		
Heat lost in pipe friction, radiation, blow-down, leakage, &c.		1,691,692,100
Main turbines—		
Condensers	46,265,939,400	
Output to switchboard	15,269,734,320	
Condensate	2,559,597,900	
Lost in friction, radiation, &c.	957,150,480	
		65,052,422,100
Feed pumps—		
Exhaust	1,235,301,600	
Lost in friction and work done	204,102,600	
		1,439,404,200
Circulating pump turbine—		
Condensate	60,683,200	
Lost in friction and work done	1,141,379,600	
		1,202,062,800
		84,428,786,800

Since the reliance which can be placed on any statement of central station efficiency depends on the trustworthiness of the figures from which it is calculated, it will be well to refer to the procedure adopted at Grove-road, as we know of no station where greater care is taken to ensure the accuracy of the records. The coal comes in partly by rail and partly by barge, the consumption averaging 2458 tons per week for the year 1927. The maximum weekly consumption was 4524 tons and the minimum 973 tons. In order to keep a check on the quality delivered by each contractor the various consignments are sampled and tested, two hundred such samples taken from truck or barge being tested during the past year.

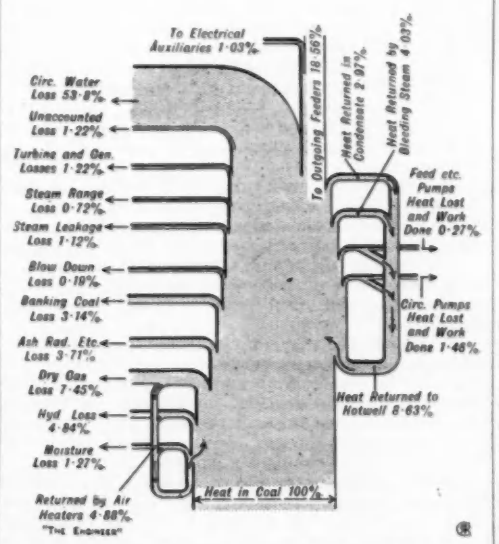
To Electrical Auxiliaries 1·03%
To Outgoing Feeders 18·56%
Heat Returned in Condensate 2·97%
Heat Returned by Bleeding Steam 4·03%
Circ. Water Loss 53·8%
Unaccounted Loss 1·22%
Turbine and Gen. Losses 1·22%
Steam Range Loss 0·72%
Steam Leakage Loss 1·12%
Blow Down Loss 0·19%
Banking Coal Loss 3·14%
Ash Rad. Etc. Loss 3·71%
Dry Gas Loss 7·45%
Hyd Loss 4·84%
Moisture Loss 1·27%
Returned by Air Heaters 4·88%
Feed etc. Pumps Heat Lost and Work Done 0·27%
Circ. Pumps Heat Lost and Work Done 1·46%
Heat Returned to Hotwell 8·63%
Heat in Coal 100%
"THE ENGINEER"

FIG. 10—HEAT BALANCE DIAGRAM

together and quartered down until about 28 lb. remains. This is carefully weighed and then spread out in a special galvanised iron tray which is placed on top of the economisers for twenty-four hours for the coal to dry. It is then weighed again and the percentage of free moisture—usually about 6 per cent.—is computed from the difference in weights. The dried coal is then placed in another bin, where the seven daily samples accumulate to about 200 lb. by the end of the week. This quantity is finally mixed and quartered down to two samples of about 10 lb.

ment tests and the quantity of each kind burnt was 10,873 B.Th.U. All these figures fall well within the range of error of even the best calorimetric determinations. The mean of all three, which represents 156 separate values, is 10,911 B.Th.U. per pound, a value which may be called absolutely identical with that obtained in the first case, for no chemist in the world would dare to swear to a difference of parts in 2700, when speaking of the calorific value of coals.

(To be continued.)

Regenerative Surface Condensers.

By THOMAS PETTY.

No. I.

(1) BASIS OF THEORY OF CONDENSER OPERATION.

THE generally accepted theory of condenser operation rests upon the assumptions that Dalton's Law of Partial Pressures applies to fluids in motion; that saturated conditions obtain throughout the condenser; and that the liquid, hereafter termed the condensate, is in thermal equilibrium with the contiguous vapour, or at some lower temperature, at all stages of the process.

The apparently simple operation of the sub-atmospheric rejection of unutilisable heat, as contemplated under theoretical or experimental conditions of constant pressure and velocity, is complicated in actual power plant units by the opposing factors of hydrodynamical resistance, and that type of regenerative action inherent in variations of fluid velocity, by effects arising from the aggregation of surface units in large masses, and by the presence of non-condensable gases.

In dealing with actual condensers, therefore, the conceptions appropriate to single-tube experiments under air-free conditions must be extended to envisage

a tripartite function and a dual partition of surface dimensions.

(2) Mass Condensation of the Steam.

Under normal conditions of operation as regards air leakage, the major portion of the tube surface is concerned with the principal function of the apparatus—the transfer to the vehicle of the latent heat of the bulk of the working fluid exhausted from the prime mover. Assuming constant velocity of the air-steam mixture and the complete absence of hydrodynamical resistance, the total pressure at all parts of the condenser may be considered as being constant, and the temperature and partial pressure relationships involved in the operation are then as shown in Fig. 1, which is drawn upon a base of percentage of total steam condensed, and in which the process is illustrated for steam containing one part by weight of air to 2000 parts of vapour. The initial temperature and partial vapour pressure are 91·6 deg. Fah. and 1·5in. of mercury respectively, the mixture under these conditions having a volume of 890,400 cubic feet per lb. of air and a partial air pressure of the relatively negligible value of 0·0004677in. of mercury.

In drawing the curves it has been further assumed that all deposited air is carried uniformly onwards in the residual mixture, *i.e.*, that both the air density at any given point and the total weight of air present in the condenser, have a minimum value.

It will be seen that the air pressure, which is given by vertical intercepts between the lines of assumed constant total pressure, and varying vapour pressure, remains insignificant in amount during the greater part of the process of mass condensation of the steam, which may be considered, therefore, as progressing under conditions of practically uniform temperature and vapour pressure.

(3) Air Concentration.

The initial phase of heat rejection in bulk under practically uniform conditions, just described, which is confined to what may be termed the primary section of the tube bank, is succeeded by and gradually merges into the final stage of the process, which is carried out over the remaining or secondary portion of the tube surface, and which, while not differing essentially in kind from the first, varies so widely from it in relative degree as to justify its being considered as a separate phase of the total operation with which the condenser is concerned.

In this secondary section of the tube bank, the non-condensable gases, which have persisted in a state of extreme though diminishing volume and tenuity, *i.e.*, of very slowly increasing pressure, during their passage of the primary surface, and which arrive at the section whilst still too distended by water vapour for evacuation, are greatly reduced in volume by the condensing-out of a further portion, small in absolute magnitude compared to that originally entering the condenser, of the residual vapour with which they are conterminous. This operation, contrary to that described in Section (2), proceeds, as will be seen from the right-hand portion of the curves of Fig. 1, under conditions of rapidly falling temperature and partial vapour pressure, and is accompanied by a reciprocal increase in the partial air pressure.

In drawing the figure, it has been assumed that concentration of the air to a partial pressure of about 0·1in. of mercury is required to bring the final air-vapour mixture within manageable proportions as to volume. This result is secured by a reduction in the temperature of the mixture of 2·2 deg. Fah., the final volume being 4125 cubic feet per lb. of air.

It will be noted that the cooling of the air has been grouped with the process of final devaporisation as constituting together the second phase of the tripartite function of the condenser, a course which has been preferred on account of the exceedingly small heat transfer involved in air cooling.

(4) Reduction of Condensate to Equilibrium Temperature.

The third function which falls upon the cooling surface is the final transfer of the small amount of heat liberated in cooling the condensate to the temperature corresponding to the partial vapour pressure existing adjacent to the condensate outlet. Cooling of the condensate to this extent neglects, as premised, any time factor involved in the establishment of thermal equilibrium. It may occur by direct transmission of heat at portions of the cooling surface, by re-evaporation of water deposited at higher temperature in anterior sections of the tube bank, or by a combination of both these methods.

(5) Regenerative Surface Condensers.

The reduction in temperature of the condensate described in the previous section, whilst inevitable, is an involuntary and undesirable phase of power plant operation from the economic point of view. This is especially the case if, by passage of heat from the condensate at the transmitting surfaces, it is actually brought below the temperature required to satisfy the conditions of thermal equilibrium. The desirability of maintaining the condensate at the highest temperature compatible with the required vacuum was recognised at an early stage of the modern period of condenser development, and was one of the factors which led to designs based upon the principle of compartmental drainage. These were successful in a considerable measure as regards condensate temperature, but the extended steam path and reversals of flow which characterised the original types gave rise to an amount of resistance which was prejudicial to the efficiency of the general process of energy transformation, and so led to their abandonment.

In the ensuing phase the development of extremely large units with deep tube banks again brought the question of high resistance, and the depression of condensate temperature which accompanies it in closed tube banks without compartmental drainage, to an acute stage.

The modern regenerative condensers seek to conserve a maximum temperature in the condensate by the employment of designs embodying in varying number and degree the features of modified forms of compartmental drainage, reduced hydro-dynamical resistance, the utilisation of the reheating effect inherent in changes of velocity, true regenerative heating of condensate previously cooled, the protection of the condensate from the influence of resistance and of the partition of surface dimensions arising from the presence of air, and its formation, collection, and extraction under the highest vapour pressure compatible with the pressure, temperature and velocity of the working fluid at exit from the prime mover.

(6) Hydrodynamical Resistance and Regenerative Velocity Effects.

The hydrodynamical resistance attending the passage of steam into a condenser and through the tube bank, by substituting a falling pressure gradient of approximately the same mean level for the theoretical uniform total pressure conditions of Fig. 1,

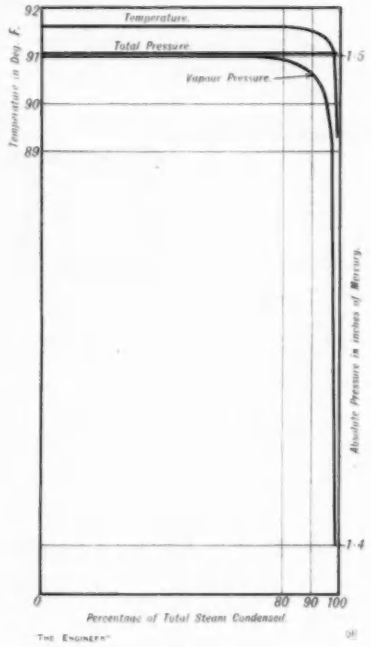

FIG. 1

bears upon the efficiency of power plants equipped with condensers of ordinary type in three directions.

The initial value of the correlated temperature gradient establishes the effective temperature of heat rejection at a higher level, and so reduces the heat drop available from given initial conditions. This is of relatively small account in the cylinder and piston type of engine, but assumes considerable importance in the steam turbine, which can only exceed the economy of the piston engine by employing a much extended expansion range at the lower end of the pressure scale.

At exit from the main tube bank the partial vapour pressure of the falling total pressure gradient is lower than that associated with the theoretical uniform total pressure conditions, and so reduces the maximum possible condensate temperature in cases in which the exit from the main tube bank is contiguous to the condensate outlet, resulting in an economic loss with both types of engine.

Resistance also affects prejudicially the expenditure of power on auxiliary services, as may be seen by considering the matter from another aspect, *i.e.*, taking the case of a turbine bladed for a given vacuum, the less the resistance through the tube bank and condenser generally, the less onerous are the duties laid upon the air and circulating pumps.

The wet exhaust steam from the prime mover enters the inlet branch of the condenser, at or near the flange of which the vacuum is usually measured, under certain definite conditions as regards dryness fraction, pressure and corresponding temperature; and at a mean velocity which is a function of the area of the branch, the density, and the weight flowing. In the case of turbine machinery it has previously issued from the last rotating wheel at a higher velocity, the difference in the kinetic energies having been dissipated by shock at exit, friction, eddying, &c., thereby increasing the dryness fraction; or by partial reconversion into pressure energy in the turbine exhaust passage, in which case there will be a corresponding rise in temperature.

The velocity across the section of the condenser inlet branch is not uniform, being subject to variations caused by the original directional bias on issue from the last wheel, the reactions thereupon of the form and direction of the turbine exhaust passage, and the varying rates of condensation in the tube bank towards which the steam is flowing, as well as by those factors common to all non-uniform passages conveying fluids. These variations in velocity across sections transverse to the axis of flow, persist in greater or less degree throughout the entire condenser, and average conditions only lend themselves to simple and approximate treatment.

With a view to avoiding the presence of air in quantities above the minimum by maintaining the velocity of the mixture attempts have been made to produce constant velocity condensers, at any rate as regards the velocity between the tubes in the primary section of the tube bank. The general tendency during the flow of the steam through those of ordinary types, however, is towards a reduction of average velocity, the velocity at exit from the main tube bank usually being less than that at the exhaust inlet. In view of the fact that no external work is done and flow is continuous, although in diminishing volume, from exhaust inlet to air exit, the case would appear to be one to which Bernouilli's theorem is applicable, and reduction in velocity should be accompanied *pari passu* by reconversion into pressure energy. Pursuing this line of argument still further, there is no reason in the nature of the case why the pressure at the bottom of the condenser, adjacent to the condensate outlet, should not exceed, as a result of such reconversion, the pressure at the condenser inlet. Under favourable conditions as to partial air pressure the condensate, so far as thermal equilibrium is concerned, could then be extracted at a higher temperature than that corresponding to the vacuum at the exhaust flange, at which point a much higher velocity of flow obtains.

A consideration of the very low velocities which have been adopted in order to reduce resistance in the tube banks of even ordinary forms of condensers, indicates that there is very little scope for such reconversions of velocity into pressure energy in this part of the apparatus. As it is only the kinetic energy of uncondensed steam which is available for the process, *i.e.*, the kinetic energy of steam which is condensed is presumably converted into heat on impingement at the transmitting surface and passes with the latent heat into the circulating water, it would appear that, even if there were no resistance, the slight pressure and temperature rise obtainable from velocity conversion as the diminishing volume of steam penetrates the tube bank, would probably fail—in the secondary jet condenser action ensuing between it and the falling condensate, previously deposited at lower temperature—to counteract the general tendency to cooling of the latter as it flows over successive tubes in its progress towards the bottom of the condenser. Any reconversion of energy, to be effectual, must therefore take place prior to the tube bank, where the velocities are higher and the kinetic energy of the whole body of the steam available.

At the same time investigation shows that in condensers of ordinary type the tube bank, presenting, as it does, a series of rounded orifices, is the only portion in which a succession of efficient energy reconversions occurs, although invariably masked in tube banks of any depth by considerable hydrodynamical resistance.

To illustrate these points Table I. has been drawn up in approximate agreement with typical data of the hydrodynamical resistance of an ordinary type of condenser with closed tube bank, on the assumption that the constructional partition of surface dimensions is coincident with the operating one arising from the presence of air.

The velocity heads have been calculated on the assumption of constant homogeneous head, *i.e.*, that expansion through the condenser follows the law $P V = C$, which will not be greatly in error for condenser conditions.

Let P = abs. pressure in inches of mercury, say, at exhaust flange.
V_s = Volume of dry saturated steam in cubic feet per lb. at pressure P, from steam tables.
q = Dryness fraction at entrance.
V = Volume of wet steam entering condenser in cubic feet per lb.
Then $V = q V_s$.
And H = Homogeneous head in feet of steam $= 70{\cdot}5\ P\ V$.
H is assumed constant at all parts of the flow.

Where the velocity v is considerable, the following expression has been used—

$$\mathrm{Log_{10}}\ R = \frac{v^2}{148{\cdot}3\ H}$$

Then, if P_1 = abs. press. at the point at which the press. equivalent P_v of the velocity head is to be calculated—

$$P_v = P_1\ (R - 1).$$

For relatively small velocities, however, *i.e.*, where the equivalent pressure head is small, the effect of

expansion has been neglected, and the expression—

$$P_v = \frac{P_1 v^2}{2gH}$$

has been used. As shown in the table, from the point in the exhaust pipe at which the vacuum is measured to the tube bank, there is a fall in pressure of 0·034in. of mercury. Between these same points the steam first traverses a short length of unobstructed exhaust pipe of uniform cross-sectional area, in which the resistance will be negligibly small—about 0·0006in. of mercury—and the mean velocity throughout the length of the pipe can be taken, therefore, as being constant, and equal to the initial value of 400ft. per second.

TABLE I.

Station in steam track.	Vacuum in inches of mercury.	Absolute total pressure in inches of mercury.	Fall of pressure in inches of mercury.	Temperature corresponding to vacuum, neglecting air pressure correction, deg. Fah.	Mean velocity in feet per second.	Pressure in inches of mercury equivalent to velocity head.
Exhaust pipe	28·5	1·5	—	91·6	400	0·0885
Approach passage at exhaust inlet	28·5 nearly	1·5 nearly	0·034	91·6 nearly	100 nearly	0·00532
Approach passage at tube bank	28·534	1·466	0·058	90·9	75	0·00292
Tube bank between first and second nests	28·592	1·408	0·015 (0·073)	89·6	—	—
Exit from primary section of tube bank	28·607	1·393		89·2	37·5	0·000693

The steam then emerges abruptly into the approach passage of the condenser body, the mean forward velocity dropping suddenly to 100ft. per second and the pressure equivalent of the velocity head from 0·0885in. to 0·00532in. of mercury. As the resistance in the exhaust pipe is negligibly small, practically the whole of this pressure drop of 0·034in. of mercury necessarily takes place in the approach passage, and is presumably to be attributed principally to the shock on emergence from the exhaust pipe and the resistance offered to the ensuing confused and eddying flow by the stiffening webs, stays, &c., not always ideally placed, by which this passage is usually intersected in large condensers.

In passing, it is of interest to note that had this fall in velocity taken place in an ideal frictionless passage, and the loss in kinetic energy been wholly reconverted into heat and by some means entirely absorbed by the condensate, the resulting rise in temperature would have been—

$$\frac{400^2 - 100^2}{2g \times 778} = 3 \text{ deg. Fah.}$$

Instead of the rise in pressure theoretically possible, and of an amount which may be roughly estimated from the last column of the table, there is an actual fall, due almost entirely to the defective orifice characteristics of the combined exhaust pipe and approach passage. Saturated conditions being assumed throughout, the heat equivalent of this fall in pressure and reduction of kinetic energy will take effect in further increasing the dryness fraction slightly.

The approach passage is sensibly uniform in area throughout its length, but owing to the circular form of the tube plate, the velocity immediately at approach to the tube bank falls to 75ft. per second, but in a manner which is also unfavourable to reconversion into pressure energy.

(To be continued.)

Functional Management.

By G. W. TRIPP, F.C.G.I., M.I. Mech. E., A.M. Inst. C.E.

IT is only in comparatively recent years that management can be said to have developed as a science, after advancing in a somewhat haphazard way, and seeking to adapt itself to the ever-changing conditions of industry. Originally, in the days of small works, the owner was his own manager, and was known by all his employees personally, a state not essentially different from that obtaining in the days of the guilds, which embodied so much that was commendable and at the same time contributed in no small manner to the building up of the country's prosperity in the Middle Ages. It was not until after the industrial revolution, when machinery was increasingly exploited and factories developed into larger units, that it became impossible for the owner to be acquainted with all the workers, and the factory system as we know it to-day began to be evolved. Incidentally, trade unionism probably owes its origin to this divorce of owner from workman, and in its early stages it was somewhat analogous to the guild system.

No longer able to control the whole organisation, the natural course was for the owner to depute part of his responsibility to an assistant, who thereupon became the intermediary between master and man. As head of the organisation the proprietor concerned himself increasingly with the business side, the securing of orders, and the general problems of administration. As his activities extended he had to leave more and more to his subordinate, who in turn found that he required more help, hence the appointment of an assistant to him. Responsibility descended by a definite chain, and unconsciously a system of management came into being, not by a regular process of development, but because, like Topsy, it "growed."

In his presidential address to the Institution of Mechanical Engineers, Mr. R. W. Allen pointed out that new inventions and improvements in design would have been of little avail unless accompanied with a corresponding improvement in the art of management. No longer could rough and ready methods be applied, the advance must be along proper lines. Even as the would-be lawyer studies the law in all its complexities, so the man that aspires to become a manager must make a study of management.

A great stimulus was given to this study in the United States of America by F. W. Taylor, who from 1880 onwards increasingly realised the limitations of what he termed the "military" system of management, better known in this country as "departmental." In this the manager is in sole control of his own department, not only organising production, and seeing the work through all its different stages, with the help of appropriate assistants, but also maintaining his own records, doing his own buying, and perhaps even being his own cost accountant; in other words, he is monarch of a kingdom in which he wields undisputed power. As long as he can keep his finger on the pulse of every activity, and control the different functions, a reasonable measure of success may be his, but expansion beyond a certain limit becomes extremely difficult and cannot yield fully satisfactory results.

Taylor saw all this and felt that as good management must involve the cheapest and best way of doing the work, after being clear as to what was required, then assuredly the determination of the most suitable means of ensuring good management was well worth investigation. He proceeded to enunciate the qualities which should be looked for in the ideal man, and he considered that these were:—Brains, education, special knowledge, manual skill, tact, energy, grit, honesty, common sense, good health. While a labourer might combine three of these qualities, it was extremely unlikely that a man possessing seven fully developed would be found, while one embodying all would be sought for in vain. With this as a base he pondered over the necessary qualifications for a foreman, a manager, and other members of the staff, only to find how short of his ideal all the individuals with which he was acquainted fell!

Having satisfied himself that no one person could fulfil all the requirements of a manager or even of a foreman, the next logical step was to divide the work so that the capacity of each member of the staff was adapted to the portion best suited to his talents. In this lay the germ of functional management.

Perhaps the operation of this system can be illustrated most appropriately by taking the simple case of the foreman in relation to the men in his shop. Under the departmental system, when an order for work was received, the foreman would proceed to demand the material required for the work, would lay-out the different operations, and arrange for the necessary work cards to be given to the operators, after having assessed the value of the work, with or without the assistance of a rate fixer. It would also be under his supervision that the work would be produced, while he would be finally responsible for ensuring that it came up to the required standard of accuracy and finish. Whatever the workman wanted in the way of tools and accessories, advice or guidance, all would be obtained through the one channel—his foreman. The man would have but one master.

Under the functional system everything would be altered. The man would receive instructions from a number of different sources, as the shop foreman would have but one function, that of production, his place being on the shop floor all the time, concentrating on one end and one alone, output. The other functions would be undertaken by other individuals, each a specialist in his own particular branch. A very simple example of functional organisation is seen in Fig. 1 (*a*), which shows the workmen as under the direction of five distinct heads; whereas in the departmental—Fig. 1 (*b*)—the men would only report to one chief. It stands to reason, however, that the number of men in the case of (*a*) could be far greater than those in (*b*), where the foreman was really exercising a five-fold function.

In the ideal shop operating on the functional plan, the raw material would be delivered to the shop at the appropriate time, the plan of campaign would be arranged outside the shop, and the work cards would be dispatched so that they were with the foreman early enough to pass to the workman. Naturally the inspection of the work produced would be under the control of another functional unit.

Expressed in a different way, the workman would be responsible to a number of chiefs, whose functions, however, would not overlap. Opponents of the functional plan fasten on this particular phase, saying in the language of holy writ, "No servant can serve two masters," and how much less half a-dozen. The man would be bewildered, and output would suffer in consequence. If this is allowed for the moment, there are compensations that more than outweigh this drawback, as will be seen when the advantages of functional management are set out. The chief of them are:—

(1) Each individual tends to become a specialist, being thoroughly conversant with his own work.
(2) Expansion is relatively easy.
(3) The spirit of team work is engendered.
(4) There is a greater uniformity of method.
(5) While the man's abilities are exploited, his idiosyncrasies are less likely to cause trouble.

Undoubtedly some men show a marked aptitude in a particular direction, while being distinctly weak in another. Under the functional system this ability will be fostered and developed, and—because the "all round" type is not required—the weakness will not even be felt, as there is no need for him to be concerned with the direction in which he does not excel.

If a member of the staff spends all his time rate-fixing, not necessarily only for one shop, he becomes more and more expert, whereas a foreman who has to

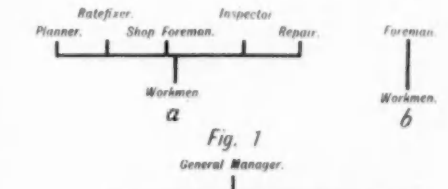

Fig. 1

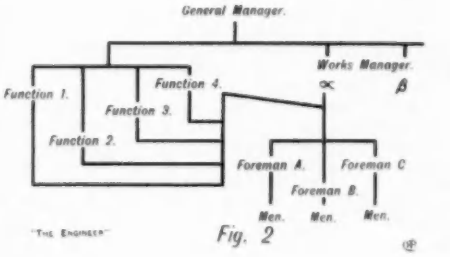

Fig. 2

do his own ratefixing is prone to be unduly liberal to save himself present trouble with his men, although frequently storing up trouble for the future, when it is realised that the cost of work has far exceeded that estimated. It is hoped that the days of the "jack-of-all-trades" foreman are approaching their end.

The fact that the different functions are common to all departments prevents a variety of methods creeping into an organisation, for before different methods are allowed in different shops, the functional chief must be fully satisfied that there is justification for a dual system, on account of the diversity of the work. "*Quot homines, tot sententiæ*" no longer obtains!

Theoretically there is no overlapping of functions; actually it frequently does occur, particularly in those organisations that formerly were run on departmental lines, but have been rearranged on a functional basis. This overlapping of duties is not an inherent defect of the system, but is usually attributable to the excessive zeal of the staff. A foreman is so anxious that there shall be no hitch in manufacture that he is prone to trespass into another man's domain, and perhaps even give instructions to an operator which will prove to be contrary to those of the functional chief. Opponents of the system thereupon vigorously restate their conviction that "no servant can serve two masters," but the exponent of the pure functional system, before subscribing to the correctness of this view, will insist on adding another clause such as "if they give contrary instructions."

The chief drawbacks of the functional system are:—

(1) The tendency of functions to overlap.
(2) The possibility of watertight compartments being formed.
(3) The dangers of an increased staff.

The first of these has already been considered, and in a properly thought-out scheme should be eliminated, but the second is more insidious. The very system has as one of its avowed objects the production of specialists, a class of individual very prone to live alone, conscious of its own importance, very zealous

in work, but brooking no interference from without. Thus, unless safeguards are introduced, before long comparatively well organised individual units will be found to lack that liaison which is so essential, and without which no advance has been made from the departmental methods, while the great boon of ready expansion will be more theoretical than real.

It may reasonably be argued that, if a scheme is good for an expanding business, it should also be suitable for a contracting one, and this is true up to a point, but there must be a limit at which the number of functional heads is too great for the total strength of employees, but nevertheless each will be anxious to emphasise the importance of his work individually. It is only then by the amalgamation of analagous functions that the system can be expected to prove a success.

In exactly the same way if a comparatively small concern is organised on the basis of a factory where functional management has proved highly efficient, it will probably be found that the smaller works have been overstaffed and the anticipated results not obtained. There is no royal road to success, each case must be treated on its merits.

From what has already been said, it will be conceded that functional management, while having many advantages, has also defects which, if not actually inherent, are very prone to appear. If then a compromise can be reached by utilising its salient features incorporated with the chief advantages of the departmental system, especially as regards one-man responsibility, the problem of satisfactory management is on the high road to solution.

This modified form of functional management, or the "line and staff" method, as some prefer to designate it, maintains the line of direct control, military in character, but parallel with it are the functional departments, staff or service as the case may be. The tables will now be turned, the workman will no longer be called upon to serve two masters, but, instead, the member of each functional unit will be in that position, but then he will only have two to satisfy, his immediate chief, to whom he will naturally turn for administration, and the factory manager, who will use his services in the work of running the factory. Expressed in concrete form, the ratefixer, ear-marked to a certain section of the factory, will look to the head of the ratefixing branch for methods and co-ordination, and all matters of principle, but the manager of that particular section will expect from him the necessary rates for the specific work that is passing through the shops, and the piecework cards, which are the contract between the worker and the foreman and manager. In all disputes that occur over prices, &c., the ratefixer in question will be regarded as one of the works staff, virtually under the control of the sectional manager.

The idea has been mooted that there is a difficulty in determining the point of demarcation between line and staff functions, but in practice, provided the responsibilities of each member of the staff are clearly defined, no trouble should arise. Broadly speaking, the "doers" are on the "line," whereas the "thinkers" are on the "staff," or, in other words, the so-called "non-producers," vital to the success of the organisation, such as estimators, planners, ratefixers, examiners, are all on the staff, and do not come under the direct control of the sectional manager, though members of the staff in each function may be indirectly attached to him.

Fig. 2 shows a simple organisation in which the different functions under the general manager are shown in relation to the works manager in charge of one of the departments (α). While each functional chief reports directly to the general manager, one of his assistants will be engaged in the work for an individual department or even shop; thus 1 α represents the assistant of the function 1, who is concerned with the activities of department α.

It will be evident that another department can similarly have functional assistants attached to it, all under the supreme control of the functional chief, who provides that co-ordination which is so very essential to success, and yet in no wise interferes with the administration of the foreman, who can guide his team and devote the whole of his energy to the vital work of producing the goods, being relieved of all staff work, yet enjoying the full benefits that are derived from it. Incidentally, he will be able to run a greater number of men efficiently, an important point in works that may be called upon to increase their output at very short notice.

Even in this modified form of functional management there is at times a tendency to the overlapping of responsibilities, and while that should be avoided as much as possible, there are some who are bold enough to affirm that even it is not devoid of merit, in that it engenders alertness among the staff, no official being prepared to see another poaching on his preserves. Alertness is a desirable quality, but it should not be attained by a waste of effort, as overlap certainly is.

Where functional management has not been a success, the failure can generally be attributed to a lack of vision or tact on the part of the organiser. Managers, foremen, and staff, as a whole, can be led, though they would strongly object to being driven, and it is noticeable that in the initial stages it is some of the most competent foremen who resent the new system. They have a tacit dislike to the new ideas, having been accustomed to engaging their own hands; they look askance at the labour section introduced by the change to functional management, and so with every other function. But if the whole matter is put to them in a straightforward and honest fashion they will not be actively hostile. If the functional chiefs are wise they will leave no stone unturned in their desire to secure as an ally the shop foreman.

The author has seen the system of modified functional organisation applied to a very conservative establishment, which had grown old under departmental methods, yet the change was accomplished without friction, and soon began to bear fruit, and make it apparent to all that there was a genuine improvement in efficiency. Those responsible for the change did not make the mistake of conferring solely with the heads of the big departments, and explaining the procedure to them, but probably for the first time in their lives, foremen, clerks, and many in a more humble position, were admitted to the council of the great, and encouraged to ask questions, and to offer constructive criticism, with a view to clearing up difficulties. By this means a state of potential antagonism was converted to one of active and sympathetic support, and each individual increasingly realised that every effort had been made to put the square peg in the square hole. While some were rapidly developing their knowledge and becoming more and more expert in their clearly defined functions, the shop foreman at the same time was appreciating the relief afforded him, enabling him to concentrate all his energies on output and to keep his promises better than he had ever been able to do in the past.

Articles on some of the specialised functions, estimating,* ratefixing,† production,‡ have appeared from time to time in The Engineer, so that their relation to the problem of functional management can easily be understood, other functions similarly contributing their quota to the sum total.

It would be extremely ill-advised to be dogmatic, or to set out in detail a scheme of functional management purporting to be applicable to every factory. No two concerns are alike in all respects; each must be treated on its merits, but it is suggested that the general principles enunciated in the foregoing article should give sufficient lead to anyone contemplating an exploration into the regions of functional organisation, and enable such a one to build up a scheme suited to his particular requirements.

The P. and O. Turbo-Electric Liner "Viceroy of India."

No. I.

The new twin-screw turbo-electric passenger and mail liner, the "Viceroy of India," which has been built for the service of the Peninsular and Oriental Steam Navigation Company by Alexander Stephen and Sons, Ltd., of Linthouse, Glasgow, is a ship of outstanding interest, whether studied from the point of view of the development of the P. & O. fleet or from the more general standpoint of marine engineering progress. In addition to taking advantage of the economies offered by high-pressure and high-temperature steam, it was also decided to adopt the electric drive, and the contract for the propelling machinery was entrusted to the British Thomson-Houston Company, Ltd., of Rugby. One reason for adopting the electric drive was that it afforded two speeds of operation, one at 16½ knots with only one alternator set and one boiler-room in operation, and another at 19 knots with the complete propelling machinery in use. Other important advantages which it offers are absence of vibration and improved manœuvring facilities which result from the availability of full power astern. As recorded in the last issue of The Engineer, the trials of the ship, carried out over the Skelmorlie measured mile, showed that at a displacement of 19,086 tons a speed of 17·1 knots could be obtained, whereas the guaranteed speed was 16·5 knots. Under these conditions the actual fuel consumption worked out at 0·74 lb. per S.H.P. hour for all purposes, including an "hotel" load of over 700 kW. It is interesting to note that this figure is almost exactly that which the owners had calculated. When referred to a displacement of 21,000 tons and a mean speed of 16·5 knots, the total fuel consumed should only be 92 tons per day, as against the 136 tons used by the "Ranchi" and "Ranpura" class of P. & O. liners with a displacement of 17,812 tons and a speed of 16·44 knots.

Some particulars regarding the ship and her propelling machinery will be found in The Engineer of September 21st, when the launch was described, and we referred again to the electrical equipment in our review of marine engineering progress on January 11th last.

* The Engineer, 7.3.24. † The Engineer, 2.3.28.
‡ The Engineer 9.7.26,.

Hitherto, no information has been given about the lay-out of the propelling machinery, but we are pleased to be able to publish, by the courtesy of the owners and builders, the machinery arrangement drawings, and views of the engine and boiler-room, which take the form of a Special Supplement. In a later article we propose to deal with further details of the main and auxiliary propelling machinery. The "Viceroy of India" is the first large liner built in this country for turbo-electric propulsion.

General Hull Design.

The lines of the hull of the "Viceroy of India" were determined by means of careful model tests, made in the National Experimental Tank at Teddington. Particular attention was paid to stability, and the design is such that positive stability is given with the ship in a light condition.

The ship has been constructed to conform to Lloyd's highest class survey and to the Board of Trade passenger regulations, special care having been taken in the arrangement of water-tight subdivisions and fire protection, while the most modern navigating instruments and life-saving equipment are provided. The main particulars of the hull, propelling and auxiliary machinery are given in the following table:—

Hull Particulars.

Length overall	612ft.
Breadth	78ft.
Depth to uppermost of ninth deck	82ft.
Gross tonnage	19,700 tons
Displacement, about	25,000 tons
Fuel tanks	22 tanks, total 2300 tons
Fresh water tanks	14 tanks, total 1500 tons

Passenger Accommodation.

First-class passengers	415
Second-class passengers	258
Officers and crew, about	420

Propelling Machinery.

Number of main propelling motors	Two
Designed output each	8500 S.H.P.
Normal running speed	109 r.p.m.
Number of main alternators	Two
Designed output each	9000 kW
Normal running speed	2700 r.p.m.
Speed with one alternator set	16·5 knots
Speed with two alternator sets	19 knots

Auxiliary Generator Sets.

Auxiliary turbo-generator sets	4 at 500 kW
Auxiliary oil-electric generator sets	2 at 165 kW
Emergency oil-electric generator set	1 at 50 kW

Boiler Equipment.

Number of water-tube boilers	Six
Designed working pressure	350 lb./sq. in.
Total steam temperature	700 deg. Fah.
Number of Scotch auxiliary boilers	Two

All fired on the "Clyde" oil fuel burning system.

The hull is divided into twelve main water-tight compartments, some of which are again subdivided, so that there are more than sixty separate water-tight compartments, many of which are employed for fuel, fresh water, machinery and other purposes. Between the various machinery compartments there are fitted water-tight doors of the Ross-Scott all-electric type, which are furnished with individual controls at each door and a master control which permits all the doors to be simultaneously closed from the navigating bridge.

The passenger accommodation is, for the greater part, situated above the level of the water-tight bulkheads, and it is divided into sections by fire-proof bulkheads fitted with steel doors of the Dreadnought double-panelled type. Further protection against fire is provided by the usual fire hose and water connections, in addition to which there is a special installation of "Phomene" fire-extinguishing plant in the stokeholds, and numerous portable chemical extinguishers in the passengers' quarters.

The life-saving equipment includes fifteen lifeboats and one motor boat fitted with wireless equipment, each designed to carry about eighty persons There are fourteen life rafts, in addition to the usual lifebuoys and lifebelts. The lifeboats are of the Rigidus pattern, and are carried in Welin-MacLachlan gravity davits, electrically-operated boat winches also being fitted. A special power plant comprising a 50-kW generator driven by a Petter heavy-oil engine is arranged on the boat deck to furnish current for the boat winches, the emergency bilge pump, and the flood lights.

The navigating equipment includes standard and steering compasses of the Kelvin-Bottomley and Baird type, with hand and motor driving sounding machines by the same makers. The telegraphs between the bridge and the engine-room were made at Woolwich by Siemens Brothers and Co., Ltd., and that firm also supplied both the docking and steering telegraphs, which are of the electric type. Other Siemens equipment includes revolution indicators, a look-out indicator, and a navigation lights indicator, besides inter-departmental telephones and distant reading thermometers. The wireless equipment is of the Siemens type, and comprises a high-powered valve transmitter capable of transmitting on C.W. or I.C.W. at all required wave lengths. There is an emergency quenched-spark transmitter, and a ship's receiver, coupled with a wave meter, and a short wave transmitter and receiver, with a separate aerial. The direction finder is accommodated within

the chart-room, and consists of a four-valve receiver capable of being tuned to all wave lengths from approximately 500 m. to 1200 m. The finder is designed to take bearings with an accuracy of approximately 1 deg., at a range of 50 miles.

PASSENGER ACCOMMODATION.

The passenger accommodation has been specially designed to meet the requirements of the company's India and cruising services, and a feature of the cabin accommodation is the provision of a single-berth cabin for all first saloon passengers, but sliding doors are fitted so that several cabins may be used to form one suite. Electrical heating is provided and there are two punkah louvre ventilating fittings in all cabins. Several of the cabins are provided with private bathrooms. The dining saloon is over 86ft. in length, and is fitted with small tables, which will accommodate all the first-class passengers at one sitting. Other public rooms include a music room, reading room, and smoking room, the latter being reached by vestibules off the promenade deck. Aft of the smoking-room is a verandah café, which overlooks a large deck area set apart for games. Large promenade deck space is provided, and a feature of the ship is the swimming bath, which is arranged forward of the machinery spaces. The entrance halls are well laid out, and lifts are provided, as well as staircases, to connect the various deck levels. The second saloon accommodation consists principally of two-berth cabins, and the public rooms are large and well arranged.

Provision for the officers and crew are made at suitable parts of the ship, the captain and deck officers being accommodated near to the navigating bridge, while the engineers and electricians have for special use in the Suez Canal. There are six cargo holds, each of which is provided with a large hinged hatch cover of steel, and is served by four 5-ton cargo winches with suitable derricks. The hatch trunking is carried through to the cargo spaces, and special compartments are provided in the lower decks for mails and for baggage and stores. The refrigerating machinery is placed on the main tank top abaft the main engine-room and was supplied and fitted on board by J. and E. Hall, Ltd., of Dartford. There are two CO_2 compressors of the vertical twin enclosed type, fitted with forced lubrication, each capable of dealing with the full duty, leaving one as a standby. Each compressor is coupled to a 45 B.H.P. "Austin" constant-current motor designed to run at such reduced speeds as may be required. There are two CO_2 condensers, two evaporators placed within an insulated chamber, one centrifugal water pump, and three brine pumps. The brine piping is carried through to two special cargo chambers and to special provision chambers, totalling in all some 20,000 cubic feet of insulated space.

MAIN PROPELLING MACHINERY.

The special two-page Supplement which accompanies to-day's issue illustrates the general layout of the main propelling machinery. It will be seen that the two main turbo-alternator sets, together with the two main propelling motors and the necessary controls, are accommodated in a single large engine-room, forward of which are the two boiler rooms with two oil fuel plant rooms containing the heating units, transfer pumps and filters arranged between the forward and aft stokeholds.

Particulars of the turbo-alternators and propelling motors are given in the foregoing table. Each turbo-alternator unit is complete with its own condensing plant and auxiliaries, and is arranged to supply current to two slow-speed synchronous motors which are coupled directly to the propeller shafts. At the centre of the starting platform there is a contactor cubicle with the necessary control apparatus for the alternators and motors. At 16·5 knots only one alternator set is required. It supplies current to both motors, the second set standing in reserve. By this means maximum fuel economy is assured both when running at the normal speed of 16·5 knots and when operating at the maximum speed of 19 knots, with both turbo-alternator sets in use. Variation in propeller speed in either direction is obtained by altering the speed of the main turbines. This speed regulation is directly under the control of the engineers on the starting platform. In one of the views in the Supplement the front of the control panels is shown. On the upper part of each wing panel there are mounted the necessary instruments for the measurement of both voltage and current in the three phases, and on a convenient shelf there is placed a Cambridge pyrometer and a kilowatt meter, with an ahead and astern indicator and a loud-speaking telephone. Below the shelf are the motor excitation controls and the circulating water pump motor starters. On the centre panel the steam pressure gauges, vacuum gauges and a standard barometer are arranged, while below, in front of the operator, there are the four levers which operate the contactors and so vary the speed and direction of rotation of the main motors. The turbo-alternator sets always rotate in the same direction, and with both sets in operation the speed and direction of rotation of either propeller can be varied irrespective of the other. When only one alternator set is used to drive both the motors they run at the same speed, but can be made to turn either in the same or opposite directions. When starting or reversing the turbo-alternators are worked at about one-fifth full speed or below, and the propulsion motors are brought up to a corresponding speed as induction motors, the field windings of the alternators being temporarily over-excited during reversing and accelerating the speed of the motors, in order to bring them almost to synchronism. Finally, the motor fields are excited to bring the propelling motors fully into synchronism, and the alternator field strength is then reduced to normal. There is a separate exciter set for each alternator, with change-over gear, so as to make these sets interchangeable if desired. In the port and starboard wings at control platform level four sets of 500-kW geared turbo-generators for auxiliary current supply are placed, and two Petter oil engine-driven generators, each of 165 kW output, are also available for port use. The auxiliary switchboard is shown in one of our views. The first panel is one of the distributing panels for the Austin constant current system. All the main propelling machinery and the four turbo-generator units were manufactured by the British Thomson-Houston Company, Ltd., of Rugby.

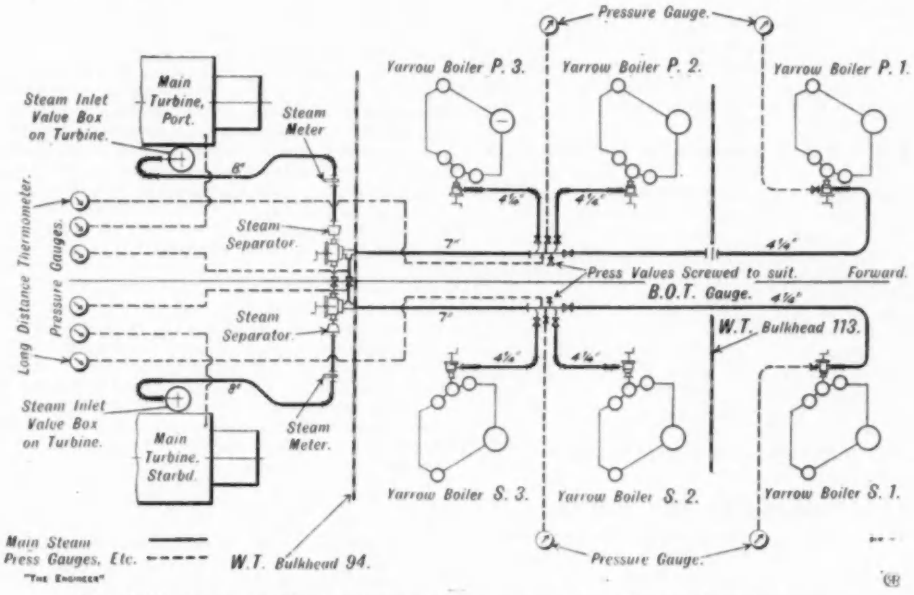

FIG. 1—DIAGRAM OF MAIN STEAM PIPES AND PRESSURE GAUGE CONNECTIONS

BOILERS AND STEAM PIPES.

A view reproduced in to-day's Supplement shows the forward boiler room, which contains two Yarrow water-tube boilers and two auxiliary Scotch boilers. All the boilers are fired on the Clyde oil fuel system, full details of which will be found in THE ENGINEER for June 8th, 1923. In the after boiler room there are four Yarrow boilers, and when running with one alternator set they generate the full quantity of steam required and the forward boiler room can be shut down. The three-furnace Scotch auxiliary boilers are only used when in port.

One of the main water-tube boilers was illustrated in THE ENGINEER of September 21st. They are of the single flow type with five furnaces, there being a single upper steam drum with one lower water drum at one side and two water drums at the other side, between which the superheater drum is placed. The steam drums have an internal diameter of 4ft. 2in. with a shell thickness of $2^5/_{32}$in., while thewater drums are 23in. internal diameter with a shell thickness of $1\frac{1}{16}$in., $1\frac{3}{16}$in., and $1\frac{1}{4}$in. The superheater drum has the same internal diameter with a wall thickness of $1\frac{1}{16}$in. On the end of this drum is mounted a Cockburn safety valve. The tubes adjacent to the combustion chamber are $1\frac{3}{4}$in. external diameter, slightly thicker tubes being employed in the first two rows next the fire. The superheater tubes are $1\frac{1}{2}$in. in outside diameter, and the water tubes above the superheater $1\frac{1}{4}$in. external diameter. A Yarrow air heater is arranged above the boiler. Evident care has been expended in insulating the heated surfaces, and we found the boiler rooms pleasantly cool and very roomy. The drum ends are enclosed by removable galvanised steel covers. All the boiler drums are made from steel forgings, and the ends are bored slightly taper to receive the pressed steel ends and manhole doors, which were supplied by Chas. McNeil, Ltd., of Kinning Park, Glasgow. The designed working pressure of the water-tube boilers is 375 lb. per square inch, with a blow-off pressure of 400 lb. and a total superheated steam temperature of 700 deg. Fah.

Taking the two forward boilers shown in our Supplement, the following figures can be given:—Generating tube surface, 4850 square feet; superheating surface, 1550 square feet; air heating surface, 5000 square feet; and combustion chamber volume, about 1198 square feet. The four boilers in the after stokehold are rated at a slightly larger output. Each of these boilers has a generating heating surface of 5700 sq. ft., a superheating surface of 1820 sq. ft., and an air heating surface of 5700 sq. ft., while the combustion chamber volume is 1319 sq. ft. The guaranteed efficiency of these boilers is 84 per cent., which efficiency was exceeded on the trial runs. All the boilers are fitted with Mumford's patented feed regulators, which are mounted on the end of the top steam drum.

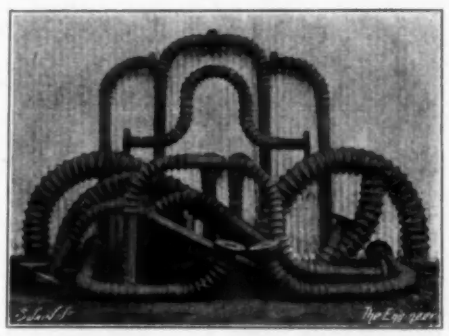

FIG. 2—CORRUGATED EXPANSION BENDS

The general arrangement of the main steam and gauge piping is shown in Fig. 1, which is self-explanatory. Reference may be made to the corrugated bends which are fitted in the steam line and are shown in Fig. 2. They were manufactured by Aiton and Co., Ltd., of Derby, and are employed in all places in the pipe line at which expansion has to be allowed for. The method of manufacture is interesting. The pipe to be corrugated is rotated in a special machine

and a burner surrounding a short length of the pipe heats it to redness. At the same time end pressure is put on and by the automatic regulation of the heating and the pressure applied, an easy outward bend is made. Successive corrugations having been formed, the pipe is then bent in the regular manner. Considerable care is taken in the process of manufacture not to stress the metal in any way. It is claimed that the corrugated bend so formed has a flexibility five times that of a plain bend of the same original section. This type of bend has long been used for power station and naval work, and it is becoming very widely adopted in the mercantile marine. Further interest attaches to these particular bends, for they are, we are informed, the first with welded-on flanges which have been accepted by both Lloyds and the Board of Trade authorities. Fig. 3 is a section

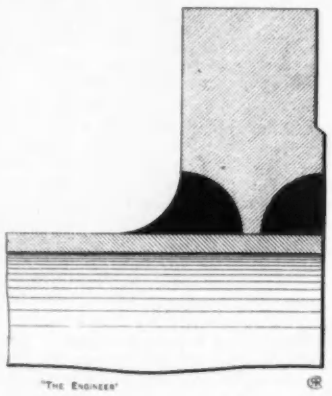

FIG. 3—CARBON ARC WELDED FLANGE

through the flange, in which the welded fillets are shown in black. A long flame carbon arc is employed and examples of such work which we inspected at Derby showed that great care is taken to produce a thoroughly sound and reliable connection. Other features of the boiler-room arrangements are illuminated bilges and indications on the stokehold floor plates to show the precise positions from which the water gauge glasses on the boiler steam drums and the smoke indicators can be observed. In order to obviate the necessity of observing the gauge glass levels from these chosen positions additional distant-reading water gauges of the "Pneumercator" type, made by Kelvin, Bottomley and Baird, Ltd., of Glasgow, are fitted on each water-tube boiler. The instrument, which is shown in Fig. 4, is mounted on a convenient

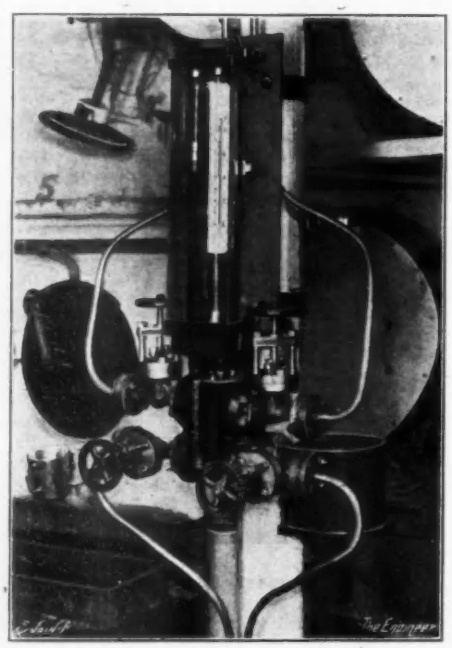

FIG. 4—DISTANT READING WATER GAUGE

pillar so that it is in full view of the boiler attendant and the engineer on watch. The drawing reproduced in Fig. 5 shows a section through the datum chamber, and the gauge glass attached to the boiler drum. The chamber is surrounded with radiating fins which cause the steam within it to condense and keep a constant level of water over a weir within it. When the centre line of the datum tube is made to coincide with the top of the ordinary gauge it is obvious that the water in the constant leg is under an unvarying head, any surplus water being returned to the water space within the boiler, and since the variable leg is connected to the water space within the drum the level of water in it corresponds to the level of the water within the boiler. These two pipes are carried down side by side from the steam drum to the gauge instrument, at which they are connected to what is really a modified form of inverted U tube. Between the two gauge glasses of the instrument a scale in inches equal in length to the ordinary boiler gauge glass is placed, and when the top of this scale is placed level with the right-hand water column the level of water within the boiler drum can be read from the left-hand column, just as in an ordinary gauge glass. In order to compensate for the possible expansion of the air imprisoned in the bend of the U tube, which would require the scale to be moved up and down, the right-hand limb of the tube is made of much larger section than the left-hand tube. By enclosing the right amount of air and fitting this larger limb the change of boiler pressure does not affect the level and no adjustment of the scale is required under working conditions. The main part of the limb is composed of a stout metal tube and gauge glasses of ordinary size are retained.

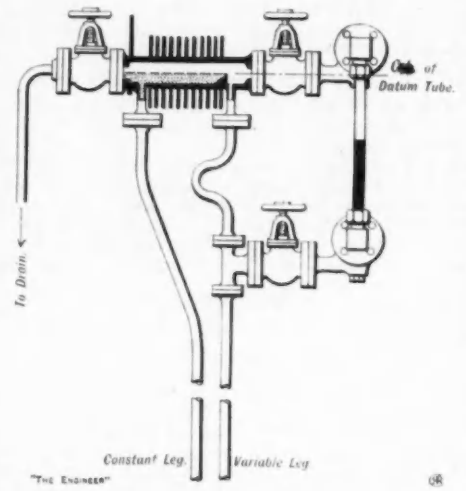

FIG. 5—DATUM CHAMBER OF PNEUMERCATOR

Suitable drain valves and shut-off valves are fitted, and we found the water level indicated on the ship to be very plain, while the gauges were quite cold.

Another feature of the boiler-room arrangement which we noted was the means provided for regulating the fan speed and the amount of air supplied to the boilers. The motor controls under the "Austin" system seemed to provide for a very fine range of air control.

In a later article we hope to deal with the main turbines and the condensers and other interesting details of the propelling machinery.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HIGH-PRESSURE LOCOMOTIVES.

Sir,—The interest exhibited generally in the revival of the well-known Perkins' system of staged steam generation for locomotives on the Prussian, P.L.M., and English railways—L.M.S.—has extended even to daily Press readers in the provinces. As with the de-Montcheuil superheater of 1850, the uniflow steam engine and uniflow locomotive of 1826–1836, and innumerable other productions by Jacob Perkins, his patented system of staged steam generation would never have been considered by our own steam users without the enterprising activity of the Germans, with whose names these Perkins' products are now associated and in skipping history will always so be labelled. To Germans, Swiss and Scandinavians, the world owes practically everything in modern steam advance by the revival of the valuable century-old machines of Jacob Perkins.

For his two-pressure boiler, Perkins found the maximum economy was realisable by a difference in pressure, as between the primary and the secondary boilers, of from eight up to twenty times and more. In the present revival for locomotives this difference does not exceed five times. To most engineers this subject of raising steam pressures in stages by the Perkins process is too unfamiliar as yet to permit of its useful discussion thermo-dynamically. As regards the reduction in wear and tear to boilers by staging the pressures the modern results prove the accuracy of Perkins' statements.

Apart from the unquestionable economy of steam production by the Perkins' process, the utilisation of the steam in the cylinders at present adopted in the railway locomotives so far built upon this system, may not prove to be the best eventually. At present the patented conception is peculiar, and is comparable to the working of ordinary compound locomotives at 900 lb. pressure, wherein, by means of a reducing valve, steam is admitted at 145 lb. direct into the receiver and to the L.P. cylinders, instead of, as customary, allowing all the steam that is consumed to pass through the single high-pressure cylinder. Such methods of auxiliary admission are made possible on certain French locomotives, as with the Nord Railway, du-Bousquet system, and, I believe, on Foden wagons for emergency purposes, but the depletion of the boiler by such method of half-compound working, is a drain on it, which is so objectionable that it is not generally allowed now in modern locomotives. Since the primary boiler feeds the secondary, there is every advantage in passing the whole of the steam through the secondary element or unit.

The balancing of the steam tonnage on all pistons at all speeds is effected to a nicety by the relative cut-offs.

In the tabulated results of tests published on page 80, January 20th, 1928, it is shown that this locomotive can supply the H.P. cylinder at 50·8 m.p.h., average steaming speed, on a cut-off of 44 per cent. average, against a back pressure of 146 lb., with the live steam from the low-pressure boiler combining with the H.P. exhaust. Moreover, it is shown that the longest of all the cut-offs—44 per cent.—with the highest of all powers—1324 D.B.H.P., under steam—together with the lowest h.p. boiler pressure, and the highest terminal pressure in the blast pipe, gives the most economical performance, that is, 16·7 lb. steam per D.B.H.P. hour, without deductions or assumptions for level line.

The average rate of expansion, disregarding the live steam admission to the L.P., is 15·7-fold. The specific rate of expansion for steam falling from 681 lb. in the valve chest to 4·7 lb. terminal, blast pressure, is 20 cubic feet ÷ 0·66 cubic foot = 30-fold. In consequence, with the initial valve chest pressure of 681 lb., a compound engine with the ratio of cylinder volumes here employed would work perfectly without any auxiliary steam admission to the L.P. cylinders. For the high-pressure locomotives designed for the L. & N.W.R. about 1880, the ratio of cylinder volumes provided was about 1 : 6, for a boiler pressure of 700 lb., with a constant cut-off of 50 per cent. for a triple-expansion in two cylinders, or a 12-fold expansion, employing saturated steam, all exhaust steam being returned to the condenser, the designer stating that his engines commonly ran for several days without any make-up of the distilled water, and in guaranteeing a consumption of 1 lb. coal per I.H.P. hour = about 9 lb. saturated steam passed through to condenser.

It is known that direct L.P. steam leakage to the L.P. cylinder causes a loss in compound engines, and this undoubtedly is the case in the new 900 lb. engines, not less than in any compound locomotives. The proof is realisable as simply as in any of those compound locomotives which are still provided with valves for introducing L.P. steam to the L.P. cylinder or cylinders. As there are many existing types of boiler on the Perkins' system, this specific question could be tried out experimentally on a straight compound engine with a cylinder ratio of about 1 : 6.

As stated on page 81, January 20th, 1928, the boiler was applied to a locomotive, class "S 10^2," of the Prussian State Railway, which, as a straight compound engine, working at 200 lb. pressure, underwent similar trial tests, and from which you reproduced a brief summary—page 577, May 31st, 1912, as hereunder repeated—and from which it is evident that, with all the economy of the Perkins' system, and the use of 900 lb. pressure, the result is not yet equal to that of pure compound working at 900 lb.

	Per D.B.H.P. hour, actual. lb.
Locomotive "S 10^2" class, with Perkins' system boiler, 900 lb. modified Schmidt-Henschel, with low-pressure steam direct to L.P. cylinders—No. 9, best result, at 44 per cent. cut-off, maximum	16·7
No. 6, least good result, with minimum cut-off, 20 per cent.	22·5
"S 10^2" straight compound, 200 lb. pressure, train 593 tons, 59·4 m.p.h., Berlin-Hannover	17·8
For an average pressure of 218 lb., coach-load 645 tons, up 80 mile bank at 52 m.p.h., no tests elsewhere have given such high values as the P.L.M Railway "Pacifics" in 1913—"P.," page 509, June 8th, 1917, The Engineer	20·4

Far better results than No. 9 may be expected from compound engines at 900 lb. pressure.

A Forty Years' Recorder.

February 25th.

THE CHANNEL TUNNEL.

Sir,—Please accept my thanks for the notice of my book, "Proposed London and Paris Railway," which has appeared in your columns, but there are one or two points which call for friendly comment.

Your reviewer admits that the calculations showing the advantages of the broad gauge from the point of view of deadweight are sound; he further agrees that the wider gauge would be advantageous in designing the locomotives, but he summarily closes the discussion by saying that he cannot accept the idea of a break of gauge at any price.

There is, however, a further argument of great importance in favour of the broad gauge. A standard-gauge Channel Tunnel would not be able to carry all the traffic offered at peak periods, but the broad gauge would be able to do so. Colonel Szlumper, the assistant general manager of the Southern Railway, recently said that the traffic to be carried through the Channel Tunnel would be of a seasonal character, and although a standard-gauge tunnel might accommodate the minimum load or something above it, he was certain that at peak times the capacity would not be adequate.

A broad-gauge railway, however, by providing through-

tracks from end to end, reserved exclusively for the tunnel service, higher speed, and increased accommodation in trains of given length, would be capable of handling fully double the traffic that could be accepted by the standard gauge and would thus be able competently to deal with peak traffic at holiday times.

As with the present railways, the broad gauge merely means for goods traffic trans-shipment, inevitable in any case, and resulting in better loading; a taxi ride across London for passengers arriving at the northern termini, and another one across Paris for those travelling beyond that city, which is certainly preferable to being shunted backwards out of the Nord Station, to crawling round the Ceinture Railway, and the subsequent further shunting with prolonged and tedious delay at the Paris southern termini. The provision of through stock between European traffic centres is already a complex problem, and if one or more coaches from or to London had to be attached to all the principal express trains on the Continent, it would become more difficult still.

The fundamental advantage of the broad gauge is, however, that it will perform the London–Paris journey in 2 hours 45 minutes, giving an attractive day-return service, as against a minimum of 5¼ to 6 hours obtainable by existing standard-gauge railways and Channel Tunnel, and even this would involve considerable capital expenditure on providing Berne loading gauge to London, some duplication of existing tracks between Paris and London, increased terminal accommodation at Victoria, and much new rolling stock for continental service.

Your reviewer does not accept my estimate of a five-fold increase in the existing traffic between England and the Continent. He thinks the Channel Tunnel would double this traffic, which is increasing at the rate of 150,000 per annum, but is doubtful if this could be multiplied by 2½, which is the ratio the present transit time bears to the proposed new one. May I put it to him another way? There are in the United Kingdom two cities, comparable in importance, population and distance from London. One is reached from London by railway and steamer; the other by rail throughout. There are three services daily from London to Dublin and twenty-one to Edinburgh.

No traffic figures are available, but to take an absurdly conservative estimate, I will assume that the London–Edinburgh traffic conveyed by through railways is merely double the London–Dublin traffic, travelling partly by railway and partly by sea. Now assume that instead of running at 48 miles per hour between London and Edinburgh, the journey time is cut to 4 hours, and the average fare reduced by one-third. In these conditions should I not be justified in anticipating that the number of passengers travelling between the two cities would be doubled, or in expecting a 2½-fold increase if the eight-hour journey were reduced to 3¼ hours? With a non-stop London–Dublin railway service in 3¼ hours, a 5-fold increase might therefore be anticipated. These figures merely presume the maintenance without advance of the pre-existing number of passenger transit hours, with allowance for the elimination of the sea crossing, and are, I think, reasonable and conservative. The London and Paris figures have been calculated on the same basis. London–Paris non-stop in 2 hours 45 minutes will be something new in the history of the world, and if the problem is envisaged in a big way, as I trust will be the case, it will yield big traffics and big financial results.

WILLIAM COLLARD.

London, W. 1, February 25th.

[It seems to us that Mr. Collard puts the cart before the horse. Is his argument that the traffic comes in proportion to the number of trains? If that were true, there would be no such thing as empty trains. The number of trains and their accommodation must be proportioned to the traffic with a reasonable amount of vision. It would be unwise to assume that the traffic would arise just because the trains were available.—ED., THE E.]

GEAR PUMPS.

SIR,—The recent article on the above subject gives a somewhat false view of the "displacement" efficiency of these machines, because it takes an annulus lying wholly outside the pitch circle as a measure of the possible theoretical delivery of one wheel. A little consideration will show that as the teeth are partly outside and partly inside the pitch circle, the maximum possible delivery per inch of length per revolution for a pair of gear wheels is the area of an annulus having outside and inside diameters equal to the pitch circle plus twice the addendum and the pitch circle minus twice the addendum respectively. Using teeth with a normal addendum, calling c the diameter of the pitch circle and n the number of teeth in one wheel, this becomes

$$\frac{\pi}{4}\left[\left(c+\frac{2c}{n}\right)^2-\left(c-\frac{2c}{n}\right)^2\right]=\frac{2\pi c^2}{n}\text{ cubic inches.}$$

The delivery is seen to be inversely proportional to the number of teeth in each wheel. This possible delivery is only $\frac{n}{n+1}$ of that obtained by the method put forward in the article, and it would appear that the wheels actually have a "discharge coefficient" larger by 12½ per cent. than the author would have us believe.

Attention is drawn to the table giving the discharge per 100 revolutions, as the quantities correspond to a volumetric efficiency of 100 per cent., not 90 per cent. as stated, using the ·84 discharge coefficient for eight teeth.

At the beginning of the article it is stated that these pumps give a continuous discharge, but it would be interesting to see a graph showing the variations in the rate of delivery during the time taken for one tooth to pass through its working zone.

In conclusion, I should like to know the maximum pressure, speed, and overall efficiency at which a gear pump of the type advocated would work when delivering 60 gallons of lubricating oil per minute, the oil having a specific gravity of ·907 at 60 deg. Fah. and viscosities of 620 sec. at 70 deg. Fah. and 136 sec. at 120 deg. Fah.

Dalton-in-Furness, ROBERT B. DOMONY.
February 21st.

SALESMANSHIP.

SIR,—In your current issue I notice a leading article drawing attention to the lack of enterprise on the part of British manufacturers in supplying you with the necessary information required to give publicity to their goods at the British Industries Fair.

This article is interesting, as it is only another instance which goes to show how all-important were the remarks of the Prince of Wales when he dealt with the question of salesmanship at the Fair dinner, and I have heard of other matters in connection with the British Industries Fair that go to show that British manufacturers must give more attention to this all-important question.

Salesmanship, as applied to engineering, is no longer the simple matter it once was; it has now become a subject for very close and scientific study. Orders will not be got, these days, by sitting down and waiting for buyers to come to us here; we have to go out into the markets and collect the orders in competition with the world's manufacturers, which means that we have to know, at first hand, the conditions prevailing in the various markets.

Salesmen to-day must be men of the highest order, and the very greatest care must be taken in their selection; we must avoid putting square pegs into round holes. For instance, it does not follow that because your salesman has been a great success in South America he will be equally successful in China or elsewhere; the question of temperament must be considered. I have seen more than one failure from this cause alone.

Again, we have to keep in mind that the salesman may be thousands of miles from his home, and, therefore, his responsibility in such cases becomes considerable; to the buyer he is the firm he represents, with all that this implies.

Heads of firms have therefore a great number of points to consider when dealing with their sales organisation, and, in my opinion, special directors should be appointed to the board to deal with these problems, and these gentlemen will have to visit the various world's markets and see for themselves the conditions that prevail. Such visits are of the greatest assistance to the local representatives or salesmen.

The Prince of Wales has struck the right note in suggesting that we give closer attention to the subject of salesmanship. In my own travels in various parts of the world, and from the correspondence I receive from overseas, I am aware of many of the deficiencies that exist. British made goods will always bear comparison with products from any part of the world and come out best, and the British workman can still produce the highest quality of workmanship; it is therefore essential and logical that we should put the highest quality of salesmanship into selling our goods.

Much is being done to this end, but let us push on with all speed and achieve the results we all desire, and so assist, as we surely must, in reducing the appalling list of unemployed. ARTHUR W. FARRER.

London, W.C., February 27th.

TENDENCIES IN STEAM TURBINE DEVELOPMENT.

SIR,—Mr. H. L. Guy's paper entitled "Tendencies in Steam Turbine Development," read recently before the Institution of Mechanical Engineers, opens with the suggestion that makers and users of steam turbines should pool their experience.

Turbines of the type to which the paper relates are employed almost solely for driving generators for the supply of electricity. Since the latter is now under the control of the Central Electricity Board, it follows that the electrical characteristics of the generators must conform to standard. This being so, it seems not unreasonable that the steam conditions under which the turbines driving these generators will operate should also be standardised wherever possible. No attempt at uniformity appears to have been made yet, however, with the unfortunate results described later on in the paper.

Mr. Guy's suggestion, if it can be carried into effect, would open the way to agreement on this point. It would also afford to turbine makers a wider range of experience on which to draw when preparing designs for machines for working under conditions hitherto untried. It would therefore—although this perhaps may be a minor advantage compared to others—react favourably upon the cost of manufacture of generating plant, and in turn on the price of electricity supplied to the consumer.

To carry the suggestion into effect an organisation to act as a clearing house for the information contributed would have to be formed. This would perform functions similar to those of the organisations for collating and distributing technical information which already exist in other countries, such as the National Electric Light Association of America.

It seems to the writer that work of the character in question hardly comes within the purview of the B.E.S.A., and that it might more fittingly be undertaken by the Institution of Mechanical Engineers. The "Proceedings" of the Institution contain few contributions dealing with modern methods of steam generation and utilisation—indeed it is surprising to find that the number of papers read before the Institution of Electrical Engineers on such a purely mechanical subject is much the greater. It is true that the Institution of Mechanical Engineers is represented on various Research Committees and that its own Steam Nozzles Research Committee has done invaluable work. These activities, nevertheless, should not preclude it from undertaking other work which would identify it more closely with the profound developments in power production which are now taking place and which would, moreover, enhance its usefulness to many of its members, to the engineering profession, and to the community at large.

It is to be hoped that Mr. Guy's suggestion will be followed up—if not by the Institution, then by some other body already existing or by one formed for the purpose. It would be interesting to know the views of your readers as to the desirability of approaching the Institution in the first instance. P. J. PLEVIN.

Cardiff, February 27th.

SIR,—The writer has read with the greatest interest Mr. H. L. Guy's paper dealing with the tendency in steam turbine design, and has had some correspondence with Mr. Guy on the subject.

The writer is particularly enthusiastic over the conclusions which may be deduced from the paper, an enthusiasm which is perhaps stimulated by the fact that he had come to the same conclusions based on more or less fragmentary calculations and reasoning along substantially the same lines as put forward in Mr. Guy's paper.

If we accept Mr. Guy's calculations as being correct, and the writer has no reason to doubt them, there appears so little to be gained by the complex systems of reheating as made necessary by extreme pressures as compared with a job designed for the highest permissible temperature and a moderate corresponding pressure that it seems inconceivable that such propositions with the greater cost and the complex arrangement and the hazards which such complications introduce in construction and operation can ever become economic.

Another point in Mr. Guy's paper which appealed particularly to the writer is his remarks concerning the absolute lack of standardisation as regards steam pressure. There would be a distinct advantage to the boiler manufacturing industry if the number of different pressures as represented by specifications could be reduced to only a few covering the steam range; such advantage could be gained without sacrifice to the users. It is the writer's belief that the subject of standardisation might become with advantage one for the consideration of a properly appointed committee of one or more of the technical engineering bodies, or of all such bodies interested in co-operation. F. H. ROSENCRANTS.

London, February 26th.

DISTANT SIGNALS.

SIR,—Surely the letter from "An Old Driver" shows a state of affairs that calls for very urgent attention. He tells us that drivers handle their trains with the "distant" as the "key" signal; that is to say, unless it is seen far ahead, on his evidence they cannot pull up before the home signals are passed, even if they wish to, so that a distant signal changing to "danger" as a train approached would be too late to prevent an accident.

To this he adds several reasons for a distant signal refusing to return to the danger position, and, taken altogether, "An Old Driver's" letter gives a startling picture of the risks run by an ignorant public quite cheerfully; but with a record of fourteen major accidents in as many months this letter throws a light on a very serious subject that can hardly be dismissed by the optimistic assurance of officials that "accidents come in waves and cannot be otherwise explained."

On "An Old Driver's" letter it would seem apparent that train weights and stored momentum have outgrown the breaking power and signalling arrangements as at present employed. Failing reduction of speed, it is clear that signalling reform throughout the railways is overdue, and if automatic stops would be ineffective at present signal spacing the pulling-up distances must be increased; but automatic control of some kind is bound to come, and those interested in its introduction will be grateful to "An Old Driver" for his public-spirited letter.

February 23rd. ONE INTERESTED.

BY a clerical error in transcribing our notes, the rail level crossings at Newark and Retford, mentioned by Major Horace Myers in his letter in our issue of February 8th, were unfortunately omitted. The crossing at Newark was opened on July 15th, 1852, when the Great Northern line from Peterborough to Retford crossed the Midland Nottingham and Lincoln branch. The crossing at Retford was opened in 1849, either on July 1st, when the M.S. and L. line between Beighton Junction and Gainsborough was brought into use, or on September 4th, when the Great Northern line between Retford and Doncaster was opened. The latter crossing is of interest, inasmuch as it was never cleared up which company was the last comer. The last comer always has to pay the cost, but as the G.N. and M.S. and L. could not agree which was the last comer, they divided the cost equally.

The British Industries Fair at Birmingham.

No. II.*

In our issue of last week we criticised manufacturers for their lack of enterprise in supplying technical particulars of the plant which they proposed to exhibit. We have also advocated a more convenient situation, or travel facilities for the Show, but it appears that there is little prospect of amelioration of these latter conditions. As to the former the remedy is comparatively simple. There is, however, yet another complaint that we feel it is imperative to make before describing further exhibits. It is the scarcity of technical men in attendance on the stands. That is to say, it is difficult to find, instanter, the man who can give an answer to a technical inquiry and too many exhibitors rely upon a mere exposition of their goods for their introduction to possible buyers. It may serve very well to display coal scuttles and chimney pieces for their disposal to the general public, but an engineer likes to know something about the construction and capabilities of a machine before he makes a purchase. All too often, at the Fair, such information can only be obtained by repeated visits to a stand or by correspondence with the works office of the firm in question, while there is a tendency for the principals of firms exhibiting to delay their appearance till too late in the day.

All this is very disappointing, as the organisers of the Fair have done everything in their power to make it a complete success. The original buildings have been virtually reconstructed, so that the exhibition is continuous, yet it is segregated. That is to say, the exhibits are grouped together—in ten groups—which are quite definite in position and can be readily found without even the assistance of the plans in the official catalogue. Thus, for instance, having found one gas-heated furnace one need not walk far to find the remainder of such appliances; the oil engines are all grouped within a small compass, and small tools are collected in rows down the sides of the building. It may be that such an arrangement does not encourage a casual customer, but it certainly does facilitate the explorations of anyone intent on an individual purpose.

Taking a general view, we would say that the increase in the floor space of the Fair buildings has permitted a display more typical of the industries of our Midlands, although several trades are not represented at all, than has been possible in the past, while the traffic to and from Castle Bromwich shows plainly that there are plenty of people interested in the exhibits.

It is hardly necessary to remind our readers that the Fair closes this evening, March 1st.

* No. I. appeared February 22nd.

Ley's Malleable Castings Company, Ltd.

Ley's Malleable Castings Company, Ltd., of Derby, which claims to have the largest "Black Heart" malleable foundries in Europe, is adopting most effective methods for demonstrating the machinability of its malleable castings. At the Exhibition itself, this firm is regularly machining castings from production orders cast from this metal, and the high speeds attained, together with the excellent finish, certainly speak well for the process and show that the castings are remarkably free from hard spots. In the "Black Heart" process—which although not general in this country, is practically universal in America—lies the explanation of this character of the metal. In this process the hard combined carbon of the original white iron is broken up into soft carbon-free iron and small nodules of free carbon or graphite, and is not partially removed by means of oxidation from the surface, as in white heart malleable iron; secondly, the "Black Heart" metal permits far greater latitude in the design of the parts, as its hardness does not vary according to the local thickness of the part. The temper carbon in "Black Heart" malleable also has a mild lubricating effect, which assists sweet and free cutting, and this is shown by the photograph which we reproduce in Fig. 11. Ley's malleable—except a special grade referred to later—has no hard outer skin, such as is often found on stampings, and no fused-in sand, as on the skin of steel castings. In addition to its machinability, "Black Heart" malleable gives a tensile strength of 24 tons per square inch, an elongation of 15 per cent., and a yield point of 16 tons per square inch, with a bend test of 170 deg., all these figures being very considerably in excess of the British Engineering Standards Association specification No. 310, 1927. Current daily tests and certificates are shown at the Exhibition.

Fig. 11—Machining Malleable Castings—Ley's

The same firm is also showing a special grade of "Black Heart" with a hard pearlitic rim for castings which have to withstand heavy frictional or abrasive wear, and which, therefore, have not the machining properties of the standard product. Other exhibits on the stand are torsion and bed tests, which are being made on actual production specimens, and a number of machined castings of various degrees of complexity and size, together with corresponding parts in the unmachined state. These specimens illustrate the small amount of metal necessary for machining allowances.

Birmingham Electric Furnaces, Ltd.

A full-scale half section of a large "Birlec" furnace, which illustrates the robust method of construction and the special resistor arrangement employed, is exhibited by Birmingham Electric Furnaces, Ltd., of 55, George-street-parade, Birmingham. The heating elements consist of heavy section strip nickel-chromium, having an exceptionally long life. Owing to its size it is impossible to show a furnace of this type in operation at an exhibition. Photographs of some large installations are, however, shown, including photographs of furnaces for annealing and general heat treatment of steel and non-ferrous metals, carburising, hardening, colour firing, &c. All these installations are in commercial operation. In one case we are told the direct labour charges have been reduced by an amount equal to the cost of current, and in another—carburising—the process is being carried out much more cheaply than with modern recuperative gas furnaces. Fig. 12 shows a large box type "Birlec" furnace having a useable hearth, 6ft. 6in. long by 3ft. 9in. wide, arranged for mechanical charging and used for carburising. Two standard portable "Birlec" furnaces, belonging to a range extending from 8 kW to 40 kW, are also shown. The small one, illustrated in Fig. 13, is designed to operate with single or two-phase current, and has a hearth 30in. long by 16in. wide. It is shown oil-hardening steel parts. The larger model, which is rated at 30 kW at 440 volts, three-phase, has a hearth measuring 36in. long by 24in. wide, and is shown carburising. The portable type of furnace consists of a welded steel cylinder lined with refactory and insulating material. The hearth, however, is flat, and is covered with nickel-chromium plate. The heating elements which consist of nickel-chromium strip, are mounted in the roof, sides and hearth, which, together with the circular construction, gives a remarkably even distribution of heat, "Sil-o-cel" insulation, ranging from 4½in. to 9in. thickness, is employed.

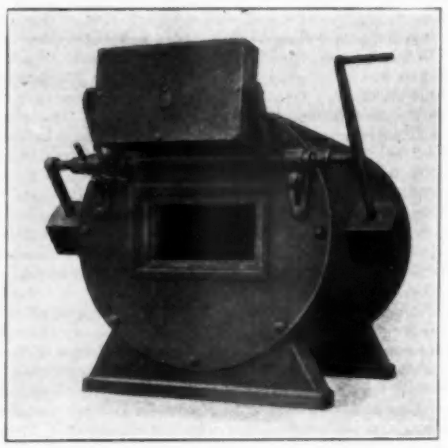

Fig. 13—Portable Electric Furnace

The door is of the maker's patented parallel motion type, giving tight closing without clamping. It is lined with refractory and insulation, the latter being covered with nickel-chromium sheet. The act of opening the door cuts off the current.

Automatic temperature control is fitted to all

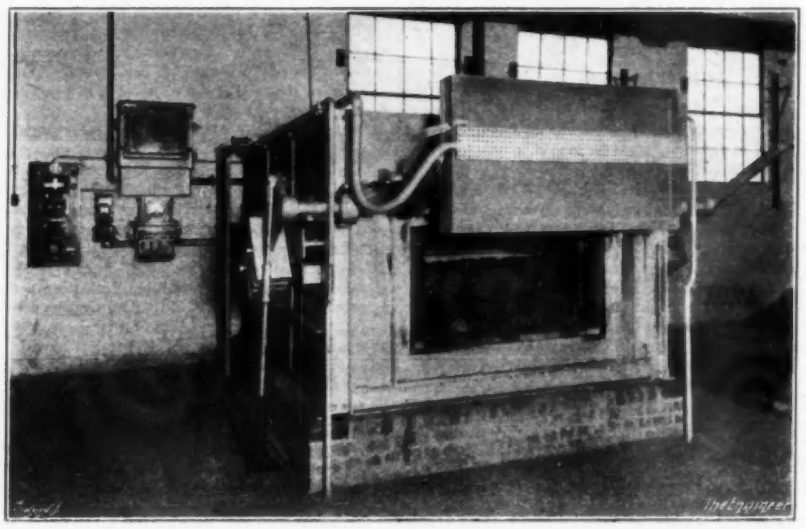

Fig. 12—"Birlec" Furnace—Birmingham Electric Furnaces Ltd.

models as standard. It is designed to maintain any desired temperature, up to 1000 deg. Cent.

REAVELL AND CO., LTD.

No less than eight different types of air compressors, many of them in operation, together with a selection of pneumatic tools, and the Reavell-Askania regulator, are shown on the stand of Reavell and Co., Ltd., of Ipswich.

One of the largest exhibits is the motor-driven

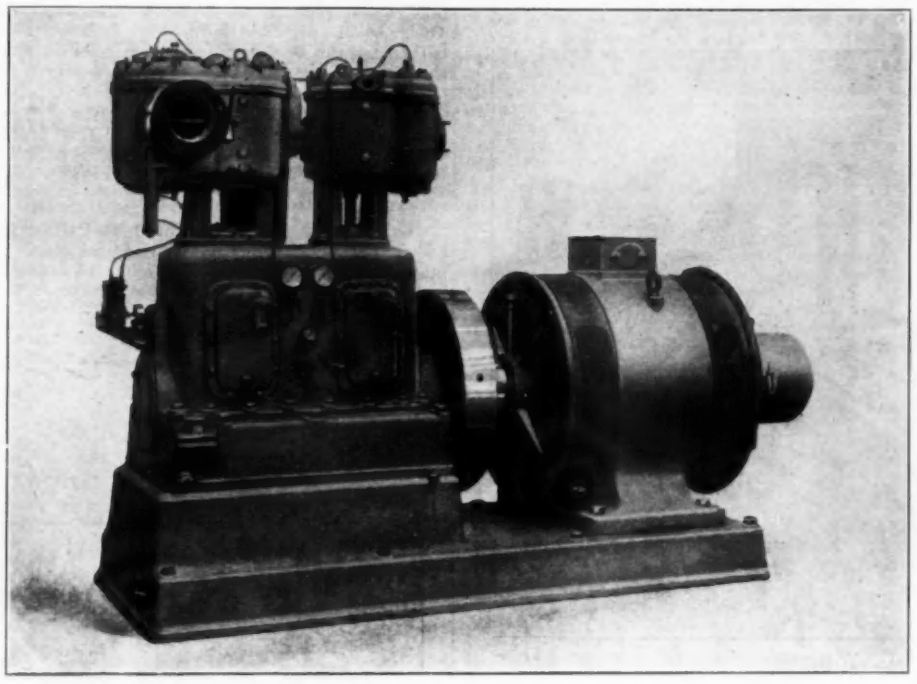

FIG 14—DOUBLE-ACTING, TWO-STAGE AIR COMPRESSOR—REAVELL

vertical double-acting two-stage air compressor which is illustrated in Fig. 14. The machine is totally enclosed and is of the two-crank type with the low-pressure and high-pressure cylinders side-by-side and a vertical multitubular intercooler at the back. The compressor is mounted on a common bedplate with the motor and a suitable fly-wheel is provided. The example shown is the smallest in a series of eleven machines with designed outputs from 500 cubic feet of free air delivered per minute up to

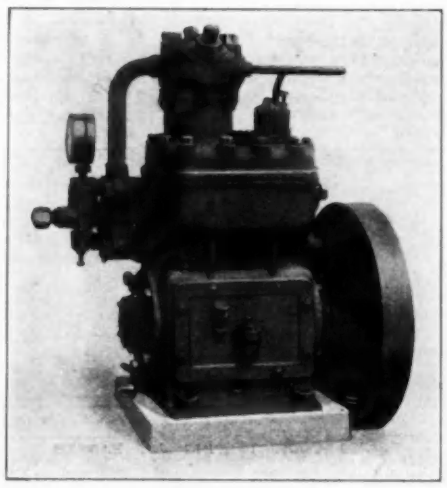

FIG. 15—HIGH-PRESSURE COMPRESSOR—REAVELL

5000 cubic feet for pressures up to 120 lb. per square inch.

Two other groups of compressors include three of the single-acting single-stage type designed for pressures up to 100 lb. per square inch, and a further three of the Reavell rolling drum type of compressors and exhausters. One of these machines is shown in operation supplying air to the Reavell-Askania low-pressure regulator system. This machine has a capacity of 30 cubic feet of free air per minute and is designed to work at pressures up to 10 lb. per square inch. A larger machine of the same type, which is sectioned in order to show the working principle, has a capacity of 400 cubic feet per minute up to pressures of 20 lb. per square inch.

We show in Fig. 15 a new type of two-stage high-pressure compressor which is designed for pressures up to 1000 lb. per square inch and has a maximum displacement of 59 cubic feet per minute. An intercooler is fitted between the two stages and the general arrangement, as shown in our engraving, is neat.

In Fig. 16 we illustrate a new type of self-contained compressor which is electrically driven and is designed for garage and service station work. This set is shown in operation on the stand. The compressor, which has a piston displacement of 5¼ cubic feet per minute, is an air-cooled machine fitted with an after-cooler, and cooling is effected by a fan type of belt pulley which directs a continuous stream of cold air on to the large cooling fans. Both the compressor and its 1½ B.H.P. driving motor are mounted on the top of the air receiver, which is 18in. diameter with a length of 42in. The automatic switch stops the motor when 160 lb. pressure has been reached and re-starts it when the pressure has again dropped to about 130 lb. The complete set only weighs about 600 lb. Other types of small compressors include portable machines for sub-station work and hand and belt-driven machines for the starting of internal combustion engines.

The pneumatic tools include a range of heavy and light "John Bull" concrete breakers, mining picks and pneumatic spades for excavating clay, chalk, marl and disintegrated rock. A selection of the last-named tools is shown. It includes examples of the short and the extended handle type which are employed for trenching and down digging. With these tools the makers claim that effective work can be done on air pressures as low as 40 lb. per square inch, although the most suitable pressures are from 60 lb. to 80 lb. per square inch.

The Reavell-Askania regulator, exhibited on the

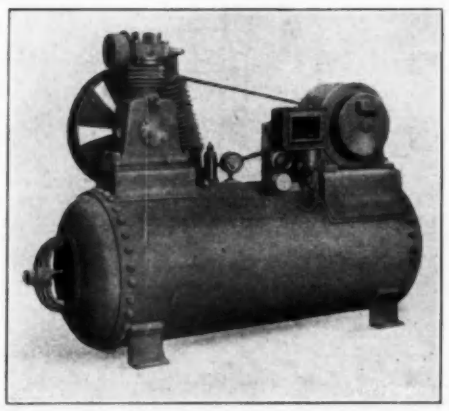

FIG. 16—COMPRESSOR UNIT—REAVELL

stand, is of the low-pressure type, and is arranged to maintain a constant pressure before a small butterfly valve, which is inserted in a length of piping connected to the electrically-driven rotary air compressor previously referred to. The general arrangement of the demonstration unit is shown in Fig. 17. It will be noticed that the butterfly valve is operated by a crank type of control cylinder, and that the regulator itself is mounted on a pedestal which also serves to house the oil pumping unit.

The method of working is briefly as follows:—The source of pressure is connected to a soft leather diaphragm "E" by means of a small push rod, which operates the relay system. This system comprises an oil jet "A" which is so mounted that it can swing about a hollow horizontal pivot, and through which the operating oil at a pressure of from 50 lb. to 60 lb. per square inch enters. The jet of oil impinges on two small orifices which are arranged adjacent to one another. When the jet is at its mid position the pressure on the two orifices, which is set up by the kinetic energy of the issuing oil steam, is equal. If, however, the jet be deflected either to the left or right the pressure is

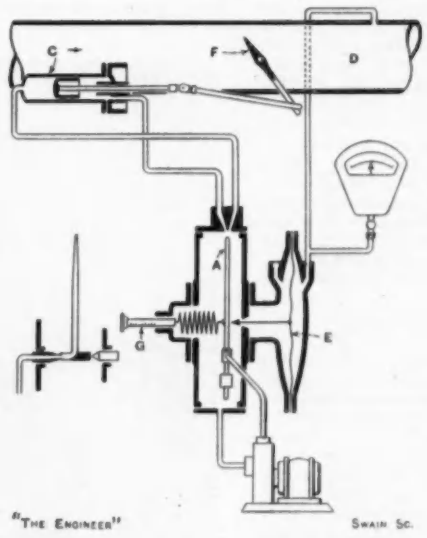

FIG. 17—REAVELL-ASKANIA PRESSURE REGULATOR

increased at the one orifice and it falls at the other. The two orifices are connected one to either end of the control cylinder "C" containing the piston, which sets in motion the butterfly valve or other organ, the purpose of which is to effect the desired correction in the pressure system. Any necessary adjustment can be made by means of the plunger "G," which controls the tension of the regulator spring.

Many plants of the low-pressure type similar to

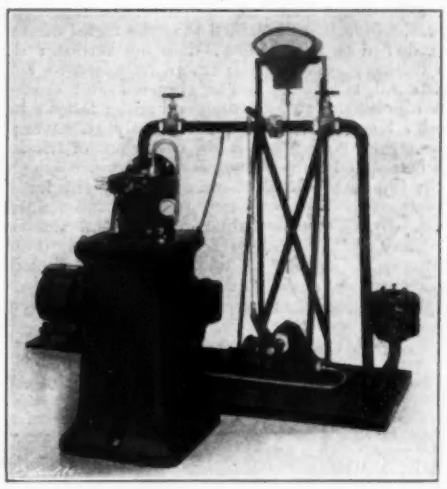

FIG. 18—REAVELL-ASKANIA GAS REGULATOR

that herewith described have been supplied during the past year for gasworks and coke-oven plants. Among these we may recall the installation for the Bolton Gasworks, a description of which will be found in our issue of June 1st, 1928.

GUTTA PERCHA COMPANY.

The exhibits of the Gutta Percha Company, of Wharf-road, City-road, London, N. 1, may be divided broadly into two classes—magnetic alloys and electrical resistance alloys. Within the first group are the alloys "Mumetal" and "Rhometal," which exhibit remarkably high magnetic permeabilities in very feeble magnetic fields. The third magnetic alloy exhibited is "Radiometal," which has been primarily developed for use in the cores of audio-frequency transformers. It is characterised by high incremental permeability. "Radiometal" enables designers to produce audio-frequency transformers which will give a uniform amplification over the whole musical scale, and it has also been used for the manufacture of very small radio transformers for use in portable wireless sets. The second group of alloys, the nickel-chromium resistance alloys, are sold under the registered name "Pyromic." The alloy "Pyromic No. 1" is characterised by its great strength at very high temperatures, and its long life at temperatures in the neighbourhood of 1100 deg. Cent. The alloy "Pyromic No. 2" is a binary alloy consisting of 80 per

cent. nickel and 20 per cent. chromium, and is claimed to be the purest nickel-chromium alloy on the market. The whole of the foregoing alloys are prepared in high-frequency induction furnaces. The firm is also showing a number of instruments illustrating the uses of the different alloys; for instance, an electric radiator fitted with "Pyromic" ribbon, and the alloys in the form of stampings, strips, sheets and castings.

W. Canning and Co., Ltd.

The exhibits of W. Canning and Co., Ltd., 133, Great Hampton-street, Birmingham, are concerned with electro-plating and its allied trades, such as lacquering and polishig; but the most novel exhibit is the chromium plating plant illustrated in Fig. 19, by which it is claimed that the initial difficulties which were first experienced in the deposition of chromium have now been overcome. The anodes and cathode rods are of solid copper, and are of a size ample to carry the current required in the process, while a hood and exhausting fan are provided for carrying away the fumes produced. The solution is properly trapped during its passage through the apparatus in order to maintain it in the best effective condition. Articles having dimensions about 6in. less in length and 12in. less in depth than the corresponding sizes of the vat can be satisfactorily dealt with in these plants. Although the characteristics of the metal chromium as a plating material are known to most engineers, it seems appropriate to emphasise them on this occasion, and to use therefore some of the expressions from one of Messrs. Canning's catalogues, where it is explained that the metal does not corrode; does not oxidise; does not tarnish; does not distort; resists acids, except hydrochloric acid; resists all alkalies; resists abrasion and erosion; is non-poisonous to foodstuffs and milk; takes a high finish; has a reflectivity second only to silver; is harder than glass; has a low coefficient of friction; can be applied to most metals and alloys.

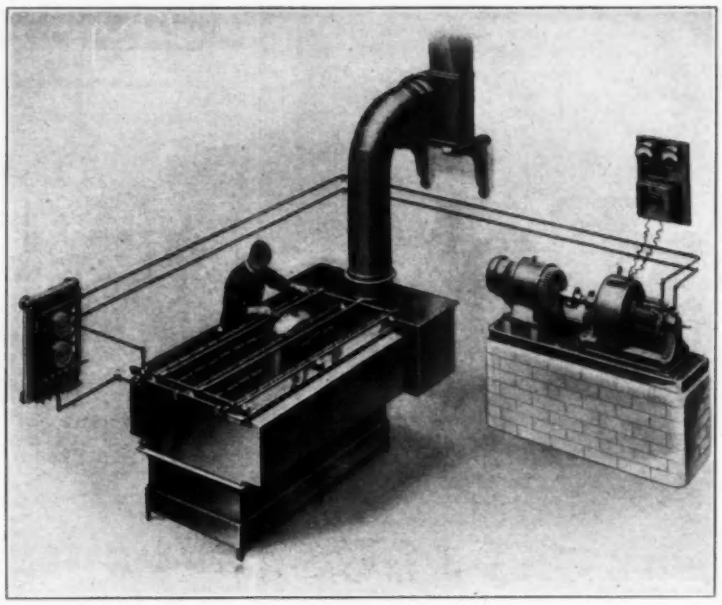

Fig. 19—Chromium Plating Plant—Canning

On the same stand there are also plant for the deposition of nickel at comparatively high temperatures, with a corresponding reduction of the time necessary for the production of a film of any desired thickness, a variety of low-voltage electro-plating generators, and some polishing lathes and apparatus for the application of lacquers by means of spraying.

George Finney and Co.

The pelleting and tableting machine illustrated in Fig. 20 is shown by George Finney and Co., of Berkley-street, Birmingham. It is, it will be seen, provided with a hopper for the reception of the powder to be pressed. Beneath this hopper there is a substantial slide through which there is a hole with sufficient capacity, in the way of powder, for a single pellet. The slide is reciprocated, so that it alternately comes under the hopper and over the pressing dies. In this way, it is always assured that the dies are properly filled. The thickness of the pellet is determined by a micrometer adjustment, which determines the height of the lower ram. This ram is also used to eject the finished pellet. The actual pressing is, of course, effected by the top ram. On the same stand there are some hydraulic presses and a machine for cutting up scrap paper, to make soft packing by means of grooved rolls.

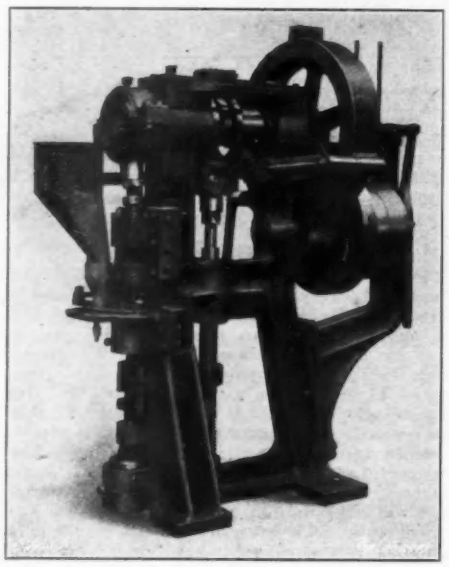

Fig. 20—Pelleting Press—Finney

Braithwaite and Co., Ltd., and Steatite and Porcelain Products, Ltd.

Visitors to the Fair have had an opportunity of seeing a transmission line tower of the type which will be used for the "grid" electrical transmission scheme in the south-eastern counties. Braithwaite and Co. Engineers, Ltd., built a tower—see Fig. 21—to show the design and means of construction, while Steatite and Porcelain Products, Ltd., fitted the tower with insulators of the type which are to be used in actual service. The æsthetic character of the tower is evident from the illustration, while the structural merits are graphically demonstrated by the fact that, suspended from the porcelain insulators on one of the cable arms are two railway goods wagons. The merit from a demonstration point of view of this test lies, of course, in the fact that the load is excentric, in that the whole of the weight is taken by one side of the tower, and is not evenly distributed as it will be when the tower is in its ultimate position. The total weight of the two trucks is nearly 15 tons, whilst the carrying capacity of each insulator is 20 tons. These insulators are given a high margin of safety so as to provide security against interruption of the current.

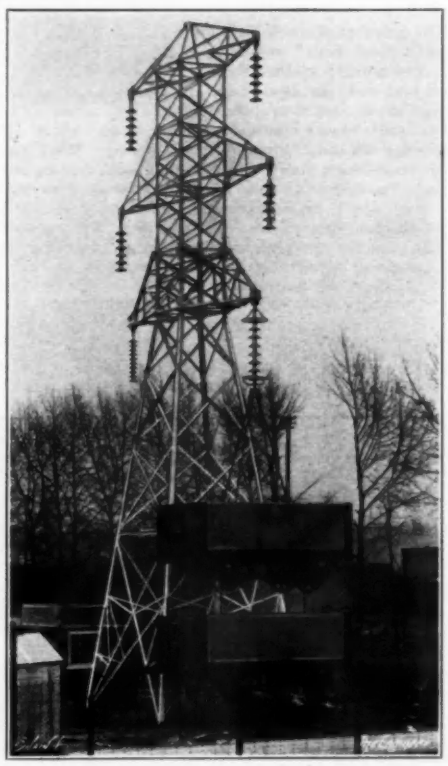

Fig. 21—Transmission Line Tower—Braithwaite

One of the great difficulties associated with high-tension transmission has been the danger of interruption in the supply owing to some failure on the line caused perhaps by a heavy lightning stroke. The mechanically-fixed spring ring insulator is said to protect the line from any such trouble, and is therefore of very great importance to power companies.

A large works covering an area of over five acres has been erected at Stourport, in Worcestershire, for the production of these insulators, which have never previously been manufactured in the British Empire.

G. B. Parkes, Ltd.

The machines on the stand of G. B. Parkes, Ltd., Crown Works, Halesowen, near Birmingham, are intended for the testing of pipes and pipe fittings for incipient leaks. For this purpose the piece to be tested is submerged in water and is subjected to an internal air pressure of about 100 lb. per square inch. Any leak is immediately disclosed by bubbles of air rising through the water. In order to expedite the work of testing some special jigs have been devised for holding various forms of fittings, and of these we illustrate two in Figs. 22 and 23. The general principle of all the jigs is to hold the fitting in a framework provided with rubber pads for closing all the openings, the pressure necessary for holding it in place being provided by means of a pneumatic cylinder. One of the pads has a small opening through which compressed air is admitted to the interior of the fitting under test. The whole jig is mounted on a counterbalanced swinging frame so that it can be readily submerged in a tank of water. The air valves are operated by a foot treadle to leave the workman's hands free to manipulate the fitting. One of the merits of this system is that castings can be tested before they are machined and the cost of working on wasters consequently eliminated. Testing machines are made by this firm for straight pipes up to 22ft. in length, and such a pipe can be tested, we are told, in fourteen seconds.

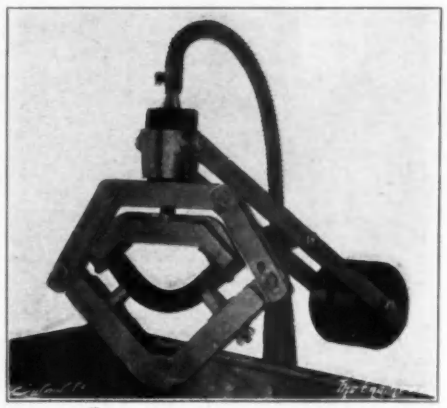

Fig. 22—Bend-Testing Jig—Parkes

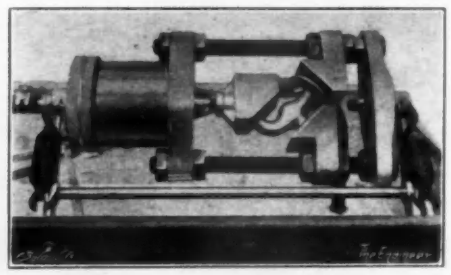

Fig. 23—Cock-Testing Jig—Parkes

(To be continued.)

A revised sheet of provisional standards in respect of the dimensions of battery crates or moulded containers, terminal posts, and cable connectors for the electric starting and lighting equipment of private motor cars has just been issued by the Society of Motor Manufacturers and Traders. The sheet gives the dimensions of five sizes of containers for both 6-volt and 12-volt batteries, ranging in capacity from 48 to 96 ampère-hours; it also gives the dimensions of terminal posts and drawings and dimensions of positive and negative cable connectors.

Railway and Road Matters.

ACCORDING to statistics issued by the Director of Census and Statistics at Pretoria, and forwarded from the office of H.M. Senior Trade Commissioner in South Africa, the number of new motor vehicles licensed in the Union of South Africa during September last embraced 2530 cars, 342 motor omnibuses, lorries, trucks and vans, and 532 motor cycles.

BY the death on February 21st of another of the passengers injured in the collision of October 12th, at Queen-street Station, Glasgow, the number of fatalities on that occasion has been raised to four. That also brings the number of passengers killed in train accidents last year to forty-seven, a figure which, if the Tay Bridge, Armagh, and Quintinshill disasters be excluded, has only once—in 1906—been exceeded since 1874.

A VERY interesting comparison between the cost of transport of goods by sea, rail and air was made by Mr. R. Bell, the assistant general manager, London and North-Eastern Railway, in a paper he contributed to the Hull (L.N.E.R.) Lecture and Debating Society on February 12th. He said that for one penny a ton of merchandise could be taken by sea over anything from 5 to 50 miles and for nearly a mile of railway, but by air it would only go for 44 yards—twice the length of a cricket pitch.

UNDER the heading "A Word for the Southern," a letter from Sir William Lawrence appeared in *The Times* of February 22nd, in which he said that having drawn the attention of Sir Herbert Walker to the fact that a number of dogs and other animals, including badgers and a fine dog otter, had been killed on the electrified track near Boxhill, instructions were given for two extra strands of wire to be added along the fencing and a batten at the foot. Sir William further remarked that Sir Herbert Walker had informed him that in future extensions a form of fencing, which will keep animals off the line, will be adopted.

IN the *Manchester Guardian* of February 19th was a leading article bearing the caption "The Gateway of the West." It referred to the revival of the proposal that had an actual beginning in the 'sixties, of making Galway a Transatlantic port. "Great liners from Canada are to unload there; the railways across Ireland are to be electrified; train ferries are to carry passengers from Dublin to Liverpool, and again from the English East Coast ports to the Continent. For those for whom the train ferry is too slow or too cheap, there will be air liners flying from Galway to England and France." In order to develop the scheme, Colonel Fitzmaurice has, it is added, resigned his post as head of the Free State Air Force.

IN his monthly message to the staff of the Southern Railway, conveyed by the *Southern Railway Magazine*, Sir Herbert Walker, in the issue for February, urges them, when opportunity presents, to give the true facts as to railway accidents. Sir Herbert observes: "The case for railway safety is really an excellent one, despite that in 1928 there were six accidents which involved a loss of forty-six lives. The figures for 1928 are not yet available, but for 1927 the total number of passenger journeys made by train was 1,651,000,000, a figure so colossal as to be almost beyond imagination. What it proves, however, is that the death-rate is one passenger for every 36,000,000 carried, that is to say, the risk of any railway passenger being killed is a one in 36,000,000 chance."

THE new Inspecting Officer of Railways at the Ministry of Transport is Lieut.-Colonel E. P. Anderson, D.S.O., late R.E., who, after a course at Woolwich and Chatham, went to India in 1903, where he served as an assistant engineer, and, from 1912, as executive engineer, on the North-Western (State) Railway. During the war he was, first, Adjutant to the Railway Construction Engineer, No. 2, and afterwards Railway Construction Engineer under Colonel D. Lyell, D.S.O. Colonel Anderson was an executive engineer under Colonel Sir G. R. Hearn, on the Khyber Railway construction, and, in 1922, he succeeded that officer in charge of the whole work, which was finished in 1925. Since that year he has filled other railway engineering and operating appointments in India, and retired as Lieut.-Colonel, as from January 14th last, on being appointed to the Ministry of Transport, as related above.

THE Canadian Pacific Railway, in renewing its rolling stock equipment, has abandoned the old type of wooden freight cars and adopted a new standard for cars of steel construction, a total of 7500 cars of this type being now on order. The new cars will be 40ft. 6in. long by 8ft. 7in. high by 8ft. 7½in. wide, and will have a capacity of 2000 bushels of grain. They will weigh little, if any, more than the old wooden box cars, and besides giving longer service will enable the grain movement to be speeded up. Leakage will be eliminated, as the riveting of all joints and connections will dispense with all nails and screws, thus giving a permanently tight car with greater rigidity. The roof is to be of steel, and inside the cars will be lined with wood. A new type of truck with a cast steel frame will give an additional degree of safety. These truck side frames are to be one integral casting, the elimination of parts in the cars as a whole being one of the most important features.

IN his report on the Charfield accident, Colonel Sir John Pringle, when dealing with the possibility of the distant signal being irregularly at "clear," said that there had been instances of wires working or controlling distant signal or other arms becoming jammed so that the arm could not return to its proper "danger" position. As the same question cropped up in connection with the subsequent Ashchurch accident, we think it desirable to say, as showing how rarely signals fail, that our file of railway accident reports shows that since the year 1899—that is, during the last thirty years—only twenty accidents inquired into in which the cause was assigned to various kinds of failures of signals have occurred. These causes were:—Insufficient counterweight, one; obstructions in the wire connections, six; obstructions in arms or arm connections, two; obstructed by snow, three; wire or signal connections frozen, three; detector binding, one; failure in power-operated signal, two; wire needed adjustment, two.

Notes and Memoranda.

RECENT American developments in the methods of constructing telephone cables permit the use of 1818 pairs of wires in "multiple-unit" design. The diameter of the cable sheath is 2⅝in., the standard for full-size cable, and the pairs are arranged, for convenience in splicing, in eighteen units of 101 pairs each. The largest previous telephone cable contained 1212 pairs. This new cable was developed by the American Telephone and Telegraph Company.

MORE than 3000 new connections were made last year in the central portion of Canadian Province of Alberta, and about 2000 customers changed from limited direct-current service to 24-hour alternating current. This extensive district is served by the Calgary Power Company and the Canadian Utilities, Ltd., a subsidiary of the International Utilities Company, which, together, have constructed 1200 miles of 13,000-volt to 66,000-volt lines into various districts in Alberta with the idea of eventually consolidating them into large systems.

MORE than 250,000 Canadians possessing radio receiving sets had paid the Government tax of 1 dollar up to the end of November, 1928, an increase of 17,000 as compared with the end of November, 1927. The returns indicate that there are 226,240 private radio receiving licences, although it is believed that more than 100,000 sets exist for which no licences have been issued. The revenue from the issue of licences is devoted by the Department of Marine and Fisheries to the improvement of radio services, about a score of radio anti-interference cars being in use.

THE Ministry of Transport has just issued a return of the number of licensed motor vehicles in use in Great Britain at the end of September last, from which it is interesting to learn that, although they form but a small percentage of the total, there is a slow, but steady, increase in the number of electric commercial vehicles in use in this country. The return shows a total of 1477 such vehicles, an increase of 114, or about 8 per cent., in twelve months. The total is made up of 168 vehicles for loads up to 25 cwt., 243 for carrying between 25 cwt. and 40 cwt., 233 between 2 and 3 tons, 466 between 3 and 4 tons, 289 between 4 and 5 tons, and 78 carrying over 5 tons, each division showing an increase.

THE Royal Microscopical Society published recently an account of the origin and development of the microscope, with a catalogue of instruments belonging to the Society and other information. It contains an interesting historical survey of the early progress of optical science, and has many photographs and drawings. It seems that the first optical instruments were spectacles, which were invented about 1280 to 1290, probably in Italy. The microscope was invented about 300 years later, probably by Janssen at Middelburg, in Holland, although other people, mostly contemporary Dutchmen, have at various times been credited with the invention. The invention of the telescope is probably also to be ascribed to Janssen; in this case also conflicting claims on behalf of other inventors have been made. The developments of the microscope in the seventeenth and eighteenth centuries are shortly mentioned.

ACCORDING to an article in *Industrial and Engineering Chemistry* of New York, by Mr. E. P. Partridge, prior to 1924 the chief field covered by the research of the Vanadium Corporation of America was the study of the various possible applications of vanadium and other alloy steels. At the present time vanadium steels are used in automobile manufacture to the average extent of 120 lb. per unit for the entire number of cars produced. The most recent application of vanadium steel in the motor industry is its adoption by certain leading makers as the standard steel for crank shafts. Vanadium has recently entered still another industry as chrome-vanadium steel used in the construction of apparatus for synthetic ammonia processes. Plain carbon steel used for this purpose becomes brittle, owing to intergranular penetration and corrosion by gases. The same resistance to intergranular corrosion has also led to the adoption of chrome-vanadium steel for the construction of oil-cracking equipment.

AS part of the research programme of the Wire Ropes Committee of the Safety in Mines Research Board, a specimen is examined from practically every colliery winding rope which fails in service. The information so acquired is supplemented by examination of specimens of cut-off winding ropes at recapping. A paper has just been published under the title of "The Deterioration of Colliery Winding Ropes in Service," by S. M. Dixon, M. A. Hogan, and J. M. Robertson—Safety in Mines Research Board Paper No. 50, H.M. Stationery Office, price 1s.—which gives descriptions of a number of typical failures and discusses the factors that operated to cause the deterioration of these ropes. The examinations, which were carried out at the Imperial College of Science and Technology, South Kensington, showed that there are three influences at work, viz.:—(1) Failure of the metal under repeated stress, known as "fatigue"; (2) wear; and (3) corrosion. Failures are generally the result of the simultaneous operation of two or more of these influences.

THE ever-present danger of introducing an insect pest when importing timber is exemplified by the presence in furniture woods of certain species of *Lyctus* powder-post beetles. The damage caused by these beetles has assumed serious proportions in the last few years, and the necessity for taking steps to counter this damage led to the investigations, the results of which are dealt with in a bulletin prepared by the Department of Scientific and Industrial Research. The first part of the bulletin describes the life-history and habits of *Lyctus* beetles, with particular reference to the species of timber attacked, and the conditions which render timber liable to infestation. The economic results of the attacks of these insects in the industries concerned, and the history of the problem in this country, are then discussed. The control and remedial measures to be taken are dealt with in some detail, and a description of the heat sterilisation of infected timber in a kiln, applicable on a commercial scale, is given. Notes are appended on heat sterilisation in relation to kiln seasoning and the liability of timbers to *Lyctus* attack.

Miscellanea.

THE first two destroyers of the flotilla built by Thornycrofts for the Chilean Navy have arrived at Valparaiso after a successful voyage in heavy weather.

THE Glasgow Lighting Inspector who recently attended a demonstration in London in connection with the Radiovisor automatic lighting unit, desires to make further experiments in his own laboratory in connection therewith. The Watch Committee recommends that he be authorised to expend a sum not exceeding £100 in connection with these experiments.

A SPECIAL committee for research on nickel-chromium-iron alloys has recently been formed by the American Society for Testing Materials, the aim being to "promote general knowledge of the properties of the alloys of this system and to develop such methods of test and ultimately such specifications as may be warranted by progress in the development and use of these alloys."

IT is proposed to erect at Chacewater, where he was born in 1753, a village hall as a memorial to the Cornish engineer, Jonathan Hornblower, one of the inventors of the compounding of steam engines. The value and importance of his inventions have, it is considered locally, never received adequate recognition, and it has been decided to make reparation to some extent by erecting the memorial hall at Chacewater upon a site offered for the purpose by Lord Falmouth.

THE seventh annual report of the Miners' Welfare Committee states that during 1928 the Committee made 840 allocations from the Fund, to the total of £856,642. Of this total, £504,901 was allocated for local schemes on the recommendations of district committees, mainly for recreation and sports grounds, institutes and halls, swimming baths, hospitals, convalescent homes and ambulence services. Research and education accounted for allocations totalling approximately £162,000. Ten pithead baths installations were put in hand during the year, besides the third and fourth of the demonstration baths. These involved allocations of £177,000.

THE *Board of Trade Journal* states that the first International Exhibition of Radio Apparatus in Rumania is to be held in Bucharest from April 15th to June 1st this year. Apparatus sent for the Exhibition will be admitted free of duty. It is considered, in view of the removal of most of the restrictions on the importation and use of radio apparatus, that British firms could participate in the Exhibition with advantage. Rumania is said to offer an increasing market for radio appliances of all kinds. Information regarding the Exhibition can be obtained from Le Comité d'Organisation, Exposition Internationale de Radio, 171, Strada Romana, Bucharest III.

ARRANGEMENTS have been made by the Liverpool Power and Lighting Committee for the supply of energy for heavy and commercial cooking apparatus at ⅛d. per kWh, except between 4 p.m. and 6.30 p.m. from October 1st to March 31st. In this excepted period the lighting rate will be applicable. Tenants of Corporation houses are to be permitted to employ slot meters, with the option of a quarterly meter. The Electric Power and Lighting Committee proposes that £125,000 be voted from the funds of the electricity and tramway estates towards relief of rates. This represents £50,000 from the electricity undertaking, compared with £35,000 last year, whilst the tramways grant is £75,000 compared with £115,000.

A PLAN to preserve the scenic beauty of Niagara Falls by preventing further erosion of the Horseshoe Falls has been submitted to Governor Roosevelt, of New York, by Paul A. Schoellkopf, president of the Niagara Falls Power Company. The project was drafted by federal power authorities in co-operation with the Niagara power officials, and provides for the erection of concrete wings in the river above the Falls to divert a greater flow of the water to the sides of the Horseshoe Falls. By arrangement between the Federal Government and Canada, the plan may be tried over an experimental period of seven years. The estimated cost would be 150,000 dollars, which would be met by the Niagara Falls Power Company.

OWING to the remarkable expansion of the copper mining industry in the Dominions it has been decided to establish two copper refineries in Eastern Canada, so as to obviate the necessity of sending the putput of the mines abroad to be refined. The Noranda Mines, Ltd., in association with the British Metals Corporation, Ltd., of London, England, and the Nicholas Copper Company, of New York, is forming a new company to erect and operate a copper customs refinery which will be erected in or near the City of Quebec, the exact position being yet undecided. The company will also build and operate a zinc refinery. An arrangement has also been made between Ventures, Ltd., which carries on extensive mining operations in the Sudbury District of Ontario, and the Consolidated Mining and Smelting Company of Canada, Ltd., for the immediate erection of a copper refinery and an electrolytic zinc-reduction works in Eastern Canada to handle the output of their mines, and do a customs business. The plants will be designed and built by the metallurgical staff of the Consolidated Company.

IN response to the invitation of the Royal Institution, representatives of many scientific and technical societies recently met in the famous lecture theatre in Albemarle-street, to consider the preliminary arrangements for the celebration of the centenary of Faraday's great discovery of electro-magnetic induction, which he made on August 28th, 1831. Sir Arthur Keith was in the chair, and in opening the proceedings he reminded those present that the Royal Institution was not only the scene of Faraday's labours, but it was also for more than half a century his home. Sir William Bragg, director of the Royal Institution, said that the proposed celebrations had been in mind a long time, and in choosing the particular discovery of August, 1831, they were recalling one of Faraday's most important discoveries, on which rested a vast body of scientific and industrial development. The occasion would give the nation an opportunity of realising the contributions to science and industry during the last hundred years. It was unlikely there would be another occasion so favourable, and if made a success, the centenary would encourage the people to go on with their work and brighten the whole outlook of the nation.

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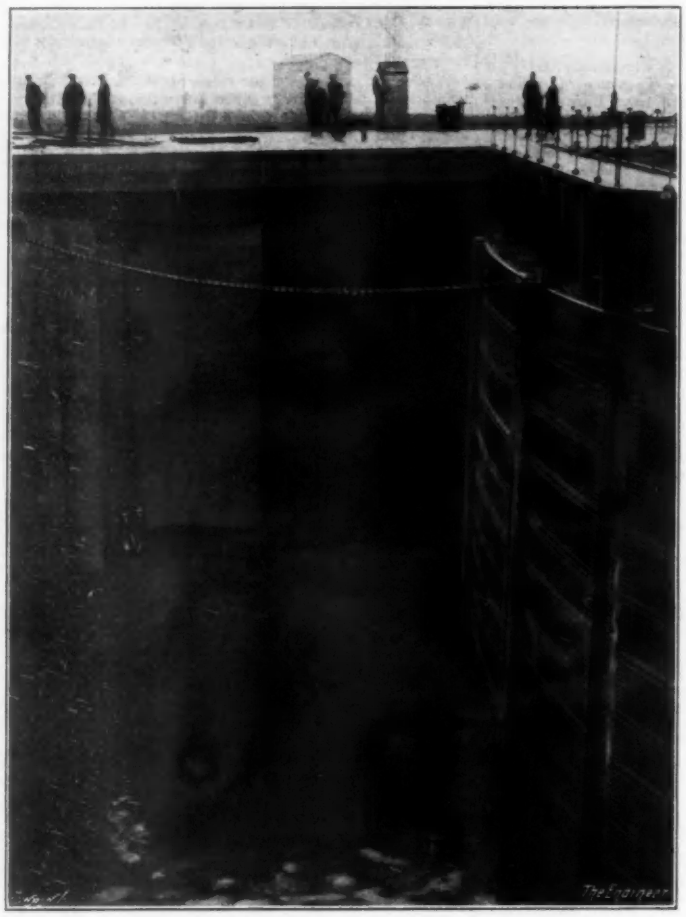

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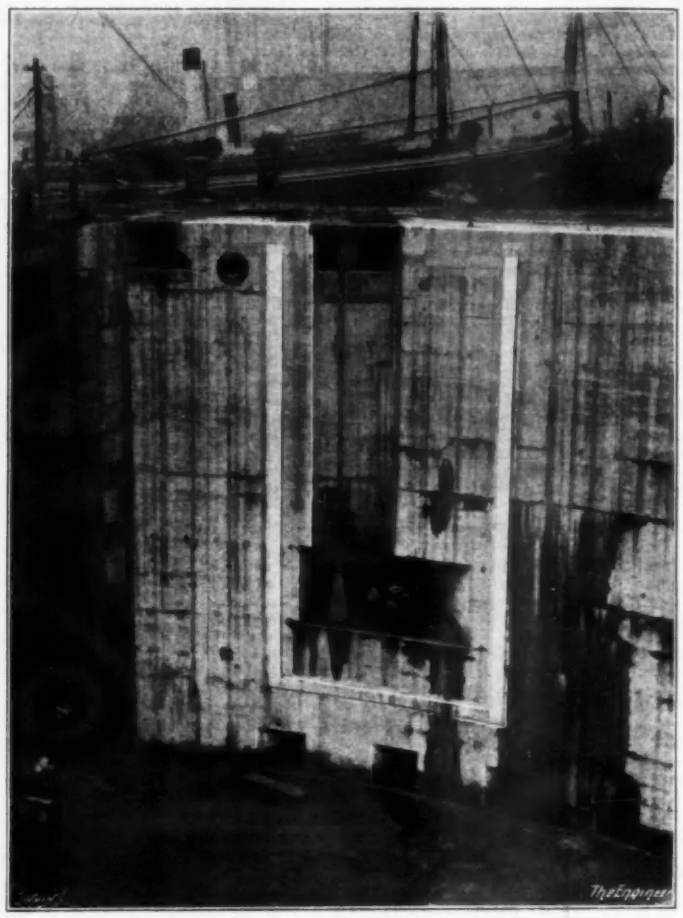

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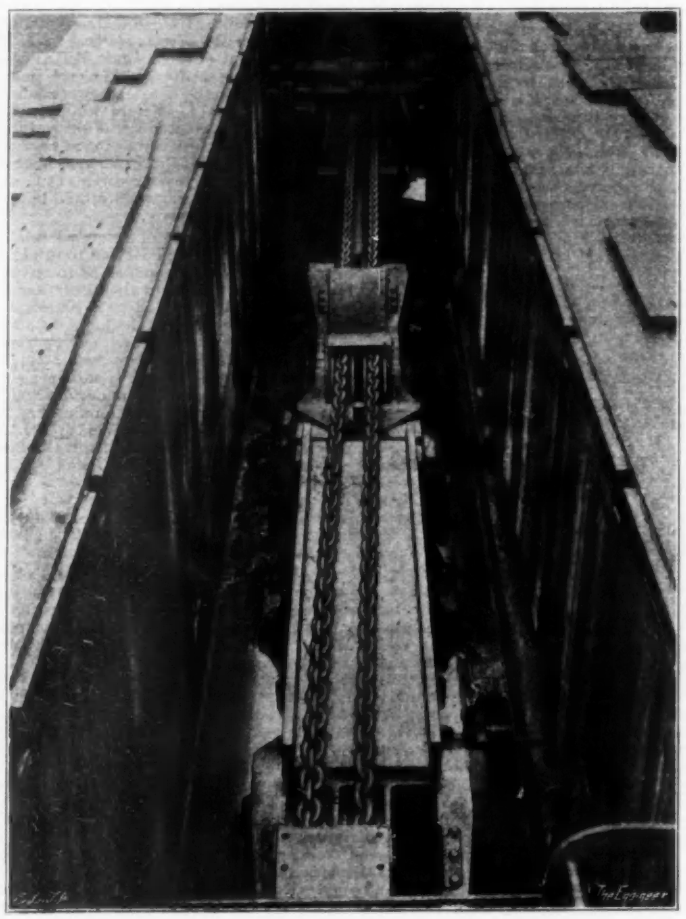

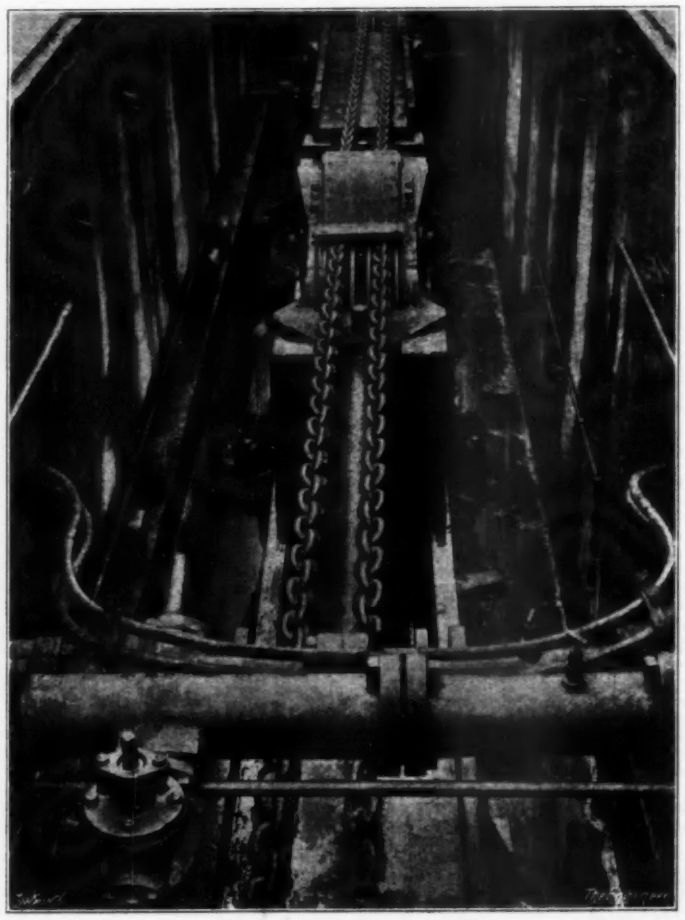

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THE ENGINEER.

MARCH 1, 1929.

The Language Question.

IT may be safely assumed that there is no body more competent to speak on foreign marketing than the British Export Society, nor any individual in a better position to give sound advice than its President, Mr. Francis W. Goodenough, chairman of the Government Committee on Salesmanship. Coming as it did so soon after the speech at the Mansion House by the Prince of Wales, in which British traders, and particularly engineers, were urged to pay closer attention to this subject, Mr. Goodenough's speech at the annual luncheon of the British Export Society on Tuesday last must be read with more than usual interest. Not that there was anything new in it, but because, unfortunately, the oft repeated truths have not been absorbed, and because there is more need than ever, in view of the activity of competitors and the ever increasing number of manufacturers, for British traders to take advantage of all the devices for marketing which already exist and to invent new devices better than the old.

Mr. Goodenough dealt principally with two aspects of the varied art of salesmanship, which have been debated as long as we can remember, and—with the packing of goods—used to form the regular material with which Consular Reports were padded out to presentable dimensions. The first of these subjects is the use of foreign languages. The opinion still prevails amongst exporting manufacturers—it is a comfortable opinion—that English is the universal language of commerce. Despite experience to the contrary, experience which has shown that foreign purchasers are more approachable through their own tongue than ours, it still prevails. As long as we held with relative ease the markets of the world, and as long as people bought from catalogues, the language problem was possibly not of very great importance. But marketing has changed. Rarely does the salesman dispose easily of his goods on sight. He has to persuade the purchaser, he has to make friends with him, he has to impress his own personality upon him, and he has to be *au fait* with the current affairs of the country in which he is endeavouring to do business. Let anyone who has no command of the language attempt any one of these things and he will soon find how futile his efforts are. The common method of the Briton abroad is to address foreigners in English spoken loud, as if it were possible to drive the sense in by volume of sound! The *nuances* of language cannot flourish in such circumstances, and the reluctant buyer is more likely to be frightened by what must appear to him as truculence than induced to take an interest in the wares of the loud-voiced pedlar. The very man who will talk persuasively and sympathetically to an English customer finds himself at a loss for blandishments and unable to sustain an argument, or even to express a simple fact, when face to face with a foreigner. He has therefore to rely upon correspondence, in which, indeed, our language is practically universal, or upon such knowledge as the customer may possess of English. It is surely unnecessary to labour so obvious a point that in conversation complete knowledge of a language gives a very great advantage, and since much selling is done by direct contact, the value of the gift of tongues is manifest. The other subject upon which Mr. Goodenough touched was the employment of foreign agents. It is a subject which has engaged the particular attention of the special commissions which THE ENGINEER has sent from time to time to report on foreign markets—South Africa, Japan, S. America, and others. Here, again, the position has changed with the increase of competition. In the past the foreign representative, frequently appointed because, though not of the nation in which he traded, he had learnt its language, were loyal servants of their British employees. But nowadays there can be little question that the best plan is to employ one of our own countrymen and to see that he is fitted out with a good knowledge of the language of his customers.

It will be observed that the two subjects with which Mr. Goodenough dealt hang closely together. Language is not merely a mechanical device for completing a transaction. The spoken voice is the organ through which it is easiest for all, save the greatest writers, to express their personality and the subtle spirit by which we put ourselves into sympathy with our fellows. The right word used in the right tone may make a friend; the wrong word—used perchance inadvertently—with the wrong tone may convert a friend into an enemy. The success of Germany is due in part to its skill in this matter. The ability with which Teutonic hosts put themselves into sympathy with foreigners is familiar to everyone who has enjoyed their hospitality. If business were no more difficult than selling stamps or postal orders through a wire grill then salesmen as automatic and indifferent as postal servants would suffice. But, as we all know, it is nothing of the kind. To-day the good salesman must be *sympatica*, he must make the purchaser his friend, and if he is dealing in technical products he must have sufficient technical knowledge to give reasonable answers to technical questions. How much more easily can this be done if he speaks fluently the "language of the country"!

The Charfield Railway Accident.

JUST after five o'clock on the morning of October 13th last a Great Western freight train was being shunted from the down main line into the down siding at Charfield, on the L.M.S. Gloucester–Bristol line, to allow the mail to Bristol to pass, when it was run into by the mail train, the driver of which had over-run three signals. A point that impressed us as we read the report—issued on February 20th—of Colonel Sir John Pringle on this collision is the chain of coincidences which led up to it, the absence of any single link of which would have wholly obviated it or mitigated the results. A down freight train was, for instance, shunted into the refuge siding at 4.47 a.m. in order to allow a parcels train to pass. When the latter had passed, the freight train was allowed to come out again, and if its driver had told the signalman before shunting that he needed to fill his tender with water and would therefore require to occupy the main line for five minutes, the signalman would have kept the train in the siding to give the Great Western freight train the road. Eventually, it was the Great Western freight train that was shunted. Again, had the mail been late by no more than ten seconds, the Great Western train would have been clear of it, though not actually inside the siding. Further, had the up freight train, which happened to be passing when the

collision occurred, arrived a few seconds earlier, the engine of the mail, when it was derailed to the right, would not have run into it, and the consequences of the collision would, probably, have been less serious. To these "elements of time and chance"—to quote the very appropriate words of Sir John Pringle—a further factor must be added. It is the inexperience of driver Aldington's fireman. We have been very much impressed during the last eighteen months or so by the recurrence of the statement that the fireman was not well acquainted with the road. It was a factor in the serious disaster at Darlington last June, and also in the fatal collision in December, 1927, at Peterborough, and in the minor collisions at Brent and at Ware in the previous October. In the Charfield case the fireman had made about thirty trips over that section of the line during the preceding $1\frac{3}{4}$ years, and "when his driver told him to look out for the Charfield distant signal, he did so, but did not know where to expect to find this signal, first, because of his limited experience, and, secondly, because the atmosphere was foggy." Yet he maintained that he saw the signal, and that it was showing a full green light, so he said "Right away" to his mate. The driver claimed that he, too, was looking out, and that he stood behind the fireman with his head over the side of the engine, and that when he got close to the distant signal—about twelve wagons' length, *i.e.*, 75 yards—he saw clearly that it was showing a green light. He, therefore, went ahead, passing the outer and inner home signals at "danger," and colliding with the tender of the Great Western train. The report observes that, despite standard rule No. 143 to the contrary, "It is not an infrequent and indeed is sometimes an accepted practice for drivers of trains, when they are assured the distant is 'clear,' to assume, when it is not possible to see them, that the signals in advance, the levers for which precede the distant signal, will also be in that position."

In the public mind the Charfield disaster stands out pre-eminently because of the terrible consequences of the fire that subsequently broke out in the *débris*, and, to quote the report, rapidly grew into a furnace, with the result that eventually the first seven vehicles of the mail and at least ten wagons were burnt out. Of the sixty or so passengers on the train, sixteen lost their lives and twenty-four were injured; whilst thirteen Post Office sorters and four servants were also injured. The recommendations as to what should be done to avoid similar accidents is obviously of more importance than those as to precautions against fire, as if the collisions can be prevented the dangers from fire will disappear also. As was to be anticipated, the report says that "a method of automatic train control, which alone can prevent the occurrence of accidents due to misreading of signals, or to failures of enginemen to obey and observe signals, should eventually be adopted." That is a subject which we discussed in a leading article in The Engineer of December 7th last, after driver Aldington had been acquitted on the charge of manslaughter. A month later the Ashchurch collision of January 8th occurred. The report of Colonel Mount thereon has not yet been issued, but it is admitted that on that occasion there was a fog of such density that the fog-signalmen had to be sent for, but had not arrived when the collision occurred. That accident was thus in a different category from the Charfield accident, and from many of the accidents which have led inspectors to recommend automatic train control. During the five years 1923–1927 that safeguard was recommended in fifteen accident reports, of which only six were collisions in foggy weather. The occurrence of the Ashchurch collision supports, however, the view we expressed on December 7th. We observed: "But for reasons advanced above, some assistance for drivers appears to be necessary. Towards that end, then, we venture to suggest that without going to the expense of equipping automatic train control—which means expensive electrical methods, possibly continuous track circuit, and refinements in maintenance on locomotives and track—a simple cab-signal system be adopted that would repeat on the footplate the condition of all distant signals. That would not, we admit, meet those cases where trains starting from dead, or shunting, pass signals at 'danger,' but in all such instances the speed is low. It would, however, assist the driver when running at speed, and that is not only the greater, but the more frequent need." We make this re-statement of our own views because Sir John Pringle remarks that the Charfield collision would have been prevented by either an unmistakable warning device on the engine, operated at the distant signal—such as is in use, observes the report, on some sections of the Great Western Railway—or a full-brake control at the outer home signal. The admission that a warning at the distant would have saved the situation is significant, but it is more significant still in view of the fact that the Automatic Train Control Committee of 1920–22 said that it was "in no doubt respecting the relatively higher value of control at stop than at distant signals." There is, however, another observation of Sir John's which has impressed us yet more. The inspecting officers, who have had occasion to mention telescoping, have generally been content with pointing out its evils and making suggestions. Not until the Darlington accident and the subsequent discussion with Mr. Gresley was what we may call the other side of the question presented. Now we get definite testimony to the effect that "it does not, however, appear that in a collision in conditions similar to Charfield complete immunity from loss of life or serious injury can be secured by the means suggested—in the Darlington report—however successful they may prove to be in resisting liability to telescoping." In corroboration of the fact that, however well fitted carriages may be with shock-absorbing devices, serious ill effects, when the momentum of a heavy train at high speed is too suddenly checked, cannot be prevented, it is stated that the guard of the mail was in the rear van, 170 yards behind the engine, yet the shock he received in the collision threw him forward in the van and dislocated his shoulder, although the vehicle itself was found on the rails and completely undamaged. The conclusion on the whole of that particular subject is that "a violent stoppage or the too rapid deceleration of a high-speed train, as the result of accident, will, however, inevitably cause serious injuries, and possibly loss of life, to occupants, even though all the vehicles in themselves are of a form of construction strong enough to resist any tendency to telescoping. . . . The policy of preventing accidents, due to the failure of enginemen to observe or obey signals, is therefore to be preferred." May we add that that view corroborates the remarks which ended a leader in our issue of January 18th: "The only reasonable way to prevent injury to life and limb in such accidents is to prevent them from occurring. It is, we submit, wiser to pursue the search for means of obviating collisions than to endeavour to build trains which could face them with impunity."

There is no necessity for us to deal with the question of the gas lighting of railway carriages; that mode of illumination, though much appreciated by many travellers, stands self-condemned. Nor need we enlarge on the subject of all-steel coaches, whose behaviour in collisions is uncertain. We may mention, however, that the L.M.S. carriage and wagon superintendent doubts whether such vehicles would, in conditions similar to those at Charfield, escape the danger of having their sides crushed in, and Sir John Pringle agrees, generally, that the wholesale replacement of the present-day type of passenger coach by all-steel vehicles should, at all events, be postponed until questions of durability, cost of maintenance, &c., of such vehicles be satisfactorily answered. In the meantime, in order to reduce liability to telescoping the number of all-steel parcel brake and luggage vans should be enlarged sufficiently to provide eventually one or more of this class and type of vehicle at the front and rear of all express and important passenger trains, and shock-absorbing buffers or collision fenders should be fitted as early as practicable to all coaching stock intended for such services.

Obituary.

SIR WILLIAM ROWAN-THOMSON.

It is with great regret that we learn of the death of Sir William Rowan-Thomson, on Tuesday last, February 26th, at his Perthshire home, The Gart, Callender. Sir William was perhaps best known to engineers by the services which he rendered to the nation during the war in connection with the manufacture of munitions and the organisation of merchant shipbuilding.

At the time of his death Sir William was only in his sixty-second year. He was the eldest son of the late John Thomson, of Glasgow, who was associated with the late firm of Robert Laidlaw and Son, engineers and ironfounders in Glasgow. After completing his earlier education at the Glasgow Academy, he went for a time to Glasgow University before beginning his apprenticeship at his father's works in 1883. There he served the full term of five years, and at the same time attended day and evening classes at the then Glasgow and West of Scotland Technical College. In 1887 he was awarded a Whitworth Scholarship. Towards the end of his apprenticeship he spent some months in Canada for his firm, and on his return to Glasgow was for some time in the drawing-office of the then Mirrlees, Watson and Yaryan Company. Subsequently, he entered the drawing-office of the late marine engineering firm of John and James Thomson, Ltd., of Finnieston-street, and in 1890 he was appointed chief draughtsman. About that time he spent some months at sea as an assistant engineer. The following year he married the daughter of the late Mr. David Rowan. In January, 1891, Mr. Rowan-Thomson, as he then was, took up managerial duties with David Rowan and Co., and seven years later he was invited by the late James Rowan to become a partner in the firm. He was intimately associated with Mr. James Rowan in working out and publishing particulars of the premium bonus system, which was used in the Elliot-street Works, and which was described in articles on "The Premium System of Paying Wages," published in The Engineer in the spring of 1902, and has since then gained much publicity. After Mr. Rowan's death, Mr. Rowan-Thomson modified the

Sir William Rowan-Thomson

plan and published an able discussion and description of it. Sir William was successful in extending the business of David Rowan and Co., and on the death of Mr. James Rowan in 1906 he became the sole partner in the firm. In 1908 he took into partnership Mr. J. Graham Young, Mr. William Tod, and Mr. William G. Weir, and retired about ten years ago.

Sir William always exhibited great interest in matters relating to industrial and labour questions, and he was elected President of the North-West Engineering Trades Employers' Association in 1909, and again in the years 1915 to 1917. Towards the end of 1915 he was made Chairman of the Glasgow and West of Scotland Munitions Management Board, and he did much to further the organisation in the munition works under his control. In December, 1916, he was made a member of the Merchant Shipbuilding Advisory Committee, and the following year he took up the post of Director of Machinery for the Deputy Controller of Auxiliary Shipbuilding. In 1918 he was created K.B.E. for the national services which he had rendered.

Sir William was a member of the Institution of Naval Architects and the Institution of Engineers and Shipbuilders in Scotland, whose representative he was for some time on the British Corporation for the Survey and Registry of Shipping. He was elected a member of the Clyde Navigation Trust in 1917, and as Convener of the Workshops Committee he took particular interest in the new dock developments. The same year he was elected a Governor of the Royal Technical College at Glasgow.

Literature.

Managerial Profit Sharing. By C. Cadby Balderston, with a Foreword by Morris E. Leeds. London: Chapman and Hall, Ltd. 1928. Pp. 127 + xiii. Price 12s. 6d. net.

It has long been felt by progressive manufacturers that management, which can now be regarded as a distinct calling, has not hitherto received the just share of the fruits of the undertakings managed. Many concerns have developed schemes of profit-sharing among employees designed to foster increased output, but few of these schemes have catered for the

higher executives. Many treatises have been written on the subject, but again mainly from the point of view of the "man on the shop floor." Mr. Balderston wisely confines his attention to the management, or, as he puts it, "our problem deals with paying managers not only wages of management, but part of the earnings of enterprise." He has tackled the problem in a very thorough and painstaking manner, first by marshalling all the available information, though that is admittedly very meagre, and then by sending a definite questionnaire to as many companies as possible, thus obtaining valuable statistics for his study. Proceeding to tabulate this information and to bring a fertile mind to bear on the problem, he has arrived at conclusions that are both interesting and illuminating. The fund of knowledge thus acquired is at the disposal of the reader, and in a manner that is very helpful and easily assimilated.

The subject is dealt with in a systematic manner, and in the introduction and Chapter I. a very good case is made for giving managers increased remuneration in the form of participation in the profits. This established, the author proceeds in Chapter II. to demonstrate that managerial profit sharing is really effective, and while he openly admits that it cannot be proved statistically, he satisfies himself in two ways: (1) by the very low rate in the mortality of plans that have been initiated, and (2) by the testimony of high executives who have had considerable experience in managerial profit-sharing. In Chapter III. is set out an analysis of the typical plans, carefully reduced to an easily comprehended form of summary. Several schemes of profit-sharing in which management partakes are discussed in detail, thereby rendering it possible to compare the principles adopted by a number of large ventures in the United States. Chapter IV. investigates some very important problems which must necessarily be solved before an equitable method can be determined. Among these might be mentioned the manner in which net profits may be computed, what percentage should be put in the management fund, the relation of salaries to profit, and the vexed question of who should be participants. Having read thus far we are in a measure prepared for the conclusions that are drawn in Chapter V. Two useful appendices complete a somewhat unusual book, unusual both in its frankness and in a wealth of "potted" information which will prove invaluable to those who are considering the adoption of the principle of profit-sharing by management. Appendix A gives a tabulation of no less than sixty-five managerial profit-sharing schemes, replete with an abundance of valuable matter, while Appendix B comprises notes on the relation of managerial profit-sharing to the function of management, emphasising on the one hand the great advantage of good management to an owner, and on the other the desirability of furnishing incentives to improve management, coupled with the development of true team work. Certainly a share in a partnership tends to make a man instantly acquire the feeling that he is a part owner in the business, and that is all to the good.

It would be very difficult to criticise the general conclusions of the author, for when he has "placed all his cards on the table," after definitely declaring that "where tried, managerial profit-sharing on a predetermined basis seems to have had exceptional success," he becomes somewhat non-committal, rightly pointing out that no scheme can be recommended as suited to all requirements. When considering what part of the profits should be shared, his answer is that it is a matter of financing and conscience, while in another place he adds that "it cannot be stated too often that the spirit behind profit sharing is more important than the method."

We are informed that "one of the most pleasing effects of the profit-sharing arrangement is the lubricating action which reduces friction in the organisation and places the emphasis on co-operative effort rather than on the petty desires of individual self-interest;" but at the same time a note of warning is sounded in the statement that "careful attention to the basis of allocating the shares is essential if the plan is to build goodwill and not ill-will, but it is equally important that it should act as a spur to greater effort, initiative and interest."

Apparently Mr. Balderston looks forward to the day when it will be possible to job-cost the work that each manager does and so assess a sort of point value to determine the appropriate amount of bonus; but he candidly admits that he has no satisfactory basis of job-costing to advocate. There is much to be said for individual salaries being used, for chances of ill-will are thereby eliminated, yet we are of opinion that it is the manager who does most towards advancing the welfare of the concern who should share most in the profits. A big field is open for exploration in this one phase of the subject. Opinion seems to be very divided as to the best average ratio between guaranteed salary and bonus, but some of the most influential owners prefer the former to be as low as possible, and only to make a man's salary large enough to cover the risks incident to the scale of living to which he is properly entitled.

Another important question is whether the scheme should reward individual effort separately or co-operatively, the exponents of the latter emphasising the value of team work, and also suggesting that a good production in one department does not attain its real value unless pace is kept with it in other branches. We feel that again it is a case of suiting the system to the particular problem, and that it is dangerous to be dogmatic.

We should like to have found a critical examination of the attempts that have been made in this country to recompense management more equitably; but although we have not traced any definite references, it is just possible that some are hidden away in one of the tables under a reference number and have threeby escaped recognition.

Whether participation in the profits should take the form of cash payment or in shares or in some other way is a subject that is fully explored, but again no definite or arbitrary pronouncement is made. We cannot help feeling, however, that the ultimate solution must be found in increasingly identifying the management's interest with the welfare of the firm, so that reverses as well as successes are felt. This will produce the added advantage of a reduction of turnover in management, as well as accentuating the desire to ensure an adequate supply of successors for managerial posts.

We have only lightly touched on several of the important issues raised in this study, but we feel that Mr. Balderston deserves to be congratulated on having limited his attention to one specific branch—that of management—thereby enabling him to treat the subject in an exhaustive manner, establishing a standard work of reference, replete with the very information that is most needed at the present day.

Practical Industrial Furnace Design. By MATTHEW H. MAWHINNEY. New York: J. Wiley and Sons, Inc. 1928. Price 20s.

IT is regrettable that the author of this book has thought fit to prefix to it an introductory chapter, because the mistakes and misstatements in this introduction are so numerous and so serious that they may well deter any reader with any knowledge of the subject from reading any further. Thus the author's opening sentence states that "the industrial use of metals is comparatively new," but the least investigation would have shown him that it is at least 5000 years old. The author could easily have ascertained this fact by referring to Garland's "Ancient Egyptian Metallurgy," published in 1927, but he appears throughout to take but little heed of the writings of authorities on the subjects he deals with, and gives the reader the impression that his guiding principle is "What I know not is not knowledge." A little further down on the first page of the introduction we find the statement that metallurgists "are frequently hazy about the operating principles of the furnaces" used by them. Even if this statement were true, which is far from being the case, metallurgists would find no help in the present work, which definitely excludes from its purview furnaces used in the smelting and production of metals, the water jacket furnace, the cupola, the blast-furnace, and the open-hearth steel furnace not being discussed at all. Fortunately for the metallurgist, any information that he may require concerning these furnaces is easily obtained from the extensive literature of the subject, seeing that these furnaces have been the object of repeated and extensive researches. It is not suggested that the limits within which the author has chosen to confine his attention do not afford sufficient scope for a book, for this they assuredly do; but it may well be claimed that these limits should have been more fully indicated by the title given to the book.

The author is particularly weak on all chemical questions, and makes numerous mistakes wherever he touches upon the chemistry of iron manufacture. For example, he states that "in the Bessemer process the impurities are removed from iron by blowing air . . . through the liquid iron," and that the "impurities are oxidised and go off in the form of gases." One of the most important and in some respects perhaps the most important of these impurities is silicon, and the author ought to know that its oxidation product, silica, does not go off in the form of a gas, seeing that he mentions silica in his list of refractory materials. Again, he describes puddling as a process "of melting pig iron from the blast-furnace in a puddling furnace and adding to the liquid iron a quantity of limestone or other material to absorb phosphorus and sulphur." It would be difficult to write a description of puddling containing more mistakes than have been introduced into the above sentence, and such mistakes are the less excusable, inasmuch as the chemistry of puddling was fully investigated fifty years ago, and as correct descriptions of the *rationale* of puddling appear in every text-book on the subject.

The author gives a review of the history of iron, about which it need only be said that he commences his history with Tubal Cain and ends by stating that case-hardening was an invention of the twentieth century! It is unnecessary to say more, but perhaps one peculiarly American contention should not be passed over in silence. The author states that waste heat boilers were first used in America, the date given being 1846. A reference to that classical work, Dr. John Percy's "Iron and Steel," the preface to which is dated 1864, would show that Dr. Percy states definitely that he saw waste-heat boilers used at the Romford Ironworks, South Staffordshire, more than twenty years before he wrote, so that such boilers were in use in England more than two years before the date of their alleged invention in America.

Disregarding this amazing first chapter, the rest of the book contains some useful information, though it must be used with discrimination. There are chapters on the Selection of Fuels, which unfortunately refer only to American conditions, on Furnace Capacity, Methods of Handling Materials, on Fuel Consumption, on Furnace Design and Construction, on Temperature Measurement and Furnace Control, and a final chapter on Practical Problems in Furnace Design is illustrated by a number of typical examples. It must be clearly understood that the author deals solely with furnaces used for what may be described as accessory operations in the treatment of metals, namely, mainly heating, annealing and enamelling furnaces, whilst the scope of the book may further be indicated by the author's classification of furnaces as "under-fired, over-fired, side-fired, direct-fired, and muffle types." The fuels considered are solid, liquid, and gaseous, but it is rather startling to find the author including "Electricity" among the list of *fuels* used for industrial furnaces. There is some useful information showing how to calculate the dimensions of a furnace for any particular purpose, and throughout the book there will be found a number of quite useful approximate practical methods of calculation. The author devotes some attention to the application of insulating material, but the only information vouchsafed as to the materials employed is that it "may be obtained from the manufacturers' catalogue."

The book will probably be found useful to readers who have sufficient knowledge of the subject to pick out the useful portions and discriminate between the reliable and the unreliable statements. Upon the whole, it may fairly be said that the author is at his best when dealing with roughly approximate practical methods, and at his worst whenever anything approaching to scientific accuracy is required.

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Motor Boat Manual. Ninth edition. London: The Temple Press, Ltd., 5-15, Rosebery-avenue, E.C. 1. Price 5s. net.

Goodwill in Industry: A Symposium by Five Practical Men. London: The London General Press, 8, Bouverie-street, E.C. 4. Price 2s. net.

Transactions of the Institution of Chemical Engineers. Vol. V., 1927. London: The Institution of Chemical Engineers, Abbey House, Victoria-street, S.W. 1.

Electricity Applied to Mining. By H. C. Cotton, M.B.E., B.Sc. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 35s. net.

The Blue Book: The Electrical Trades Directory and Handbook, 1929. London: Ernest Benn, Ltd., Bouverie House, 154, Fleet-street, E.C. 4. Price 25s. net.

Some Economic Factors in Modern Life. By Sir Josiah Stamp, G.B.E. London: P. S. King and Son, Ltd., Orchard House, Westminster, S.W. 1. Price 10s. 6d. net.

The Directory of Shipowners, Shipbuilders and Marine Engineers. 1929. London: The Directory Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 20s. net.

Annali dei Lavori Pubblici (già Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore, Ottobre, 1928. Rome: Provveditorato Generale dello Stato Libreria. 1928.

The Bristol and Somerset Coalfield: The Carbonisation of "Parkfield Large Gas" Coal. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 6d. net.

Financial, Commercial and Economic Conditions in Brazil. A Report by S. G. Irving. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. IX. By J. W. Mellor, D.Sc. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 63s. net.

The Choice of Electric Motors and Control Gear. By A. Kershaw. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 4s. net.

Die Begrenzung der Leistungssteigerung der schnellaufenden Verbrennungsmaschine durch den Steuervorgang. By Dr.-Ing. M. Christian. Berlin: V.D.I. Verlag, Dorotheenstrasse 40. Price 3·40 marks.

The Cornish Miner: An Account of His Life Above and Underground from Early Times. By A. K. Hamilton Jenkin. London: George Allen and Unwin, Ltd., Museum-street, W.C. 1. Price 12s. 6d. net.

Applied Chemistry: Vol. I., Water, Detergents, Textiles, Fuels, &c. By C. K. Tinkler, D.Sc., F.I.C., and Helen Masters, B.Sc. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. Price 15s. net.

Berechnung statisch unbestimmter Systeme. By A. Strassner. First volume. *Der einfache und durchlaufende Balken.* Berlin: Wilhelm Ernst and Sohn, Wilhelmstrasse 90, W. 8, Germany. Price 10 marks net.

The Inclusion of Partial Glides in Routine Performance Tests. By A. E. Woodward Nutt, B.A. Being Reports and Memoranda No. 1180 (Ae. 344) of the Aeronautical Research Committee of the Air Ministry. Published by H.M. Stationery Office. Price 4d. net. 1929.

Wind Tunnel Tests with High Tip Speed Air Screws. Some Experiments upon an Airscrew of conventional Blade Section, Aerofoil R & M 332, No. 3, at High Speeds. By G. P. Douglas, D.Sc., and W. G. A. Perring, R.N.C. Being Reports and Memoranda No. 1174 (Ae 338) of the Aeronautical Research Committee of the Air Ministry. London, July 1928: H.M. Stationery Office. 1928. Price 9d. net.

Locomotive Coal Tests.

By J. G. B. SAMS, A.M. Inst. Mech. E.

THE practical testing of coal consumption under ordinary conditions of every-day usage should be undertaken from time to time in order that the consumption of various classes of locomotives may be compared and checked, and a watch kept on the quality of the fuel supplied and its suitability for locomotive purposes. The essentials of such trials are that all the conditions must be as nearly parallel as possible, otherwise the trial will be vitiated. The writer recalls some coal trials on an English railway some years ago at which he assisted, the only points of similarity being the class of engine and the actual trains worked. The standard trains utilised were two out-and-home passenger trains and an out-and-home goods, but no accurate notice was taken of alterations of loads *en route* and ton-miles were not recorded, all the information secured being the inspector's report as to the behaviour of the coal and the quality of the residue, together with pounds burned per train and engine-mile. These were somewhat valueless figures, as on some trips the up goods train would consist of a full load of bacon, which is a heavy cargo, and on others of a few wagons of light goods; the passenger trains, too, would frequently have their loads, especially between intermediate places of call, considerably varied. There was also the disadvantage with the goods trains that they were liable to much casual shunting for varying intervals to allow passenger trains to pass, it apparently never being possible to run them at exact times with predetermined lay-bys for the passenger service. It would happen at times that as much as half an hour would be lost through this cause. These factors would naturally affect the consumption per train or engine-mile, and the resultant figures would often be widely different for the same coal. Another weak point in these trials was that the engine was lit up out of the coal weighed-on to the tender for the test, the quantity used for the purpose being reckoned in the per mile consumption. As this can be a widely differing amount, varying with the lighter-up and the time that it happens on that particular night to be necessary to light up at, in the writer's opinion the whole trial was vitiated before any actual running has commenced. At a later time he was surprised to see the official figures of a comparative coal test on one of the British groups in which neither the train utilised nor the class of engine were the same. In his opinion, such a trial is really valueless for any comparative purpose.

Recently he was able to conduct some trials on a colonial railway in a more accurate manner than those already mentioned, and the results are given herewith. There were three coals to be tested, Welsh, Pocahontas and New River, the two latter being American coals. Four tests were made in each case and the averages noted and compared. The locomotive employed—an American-designed and Canadian-built 4–8–0 with an eight-wheeled tender—together with the driver and fireman and the trains utilised, were the same for every test, and every effort was made to keep the loading to a standard. As the trials were held close together, the condition of repair of the locomotive can be said to be constant.

The routine employed was to weigh the coal for trial into sacks, containing 200 lb. each, and to load a known number of sacks into the previously emptied tender overnight. The engine would then be lit up as in the ordinary course of events with wood and coal from the same stack, but not from the weighed-on supply. Before leaving the shed the inspector would check the coal in the tender and have a few bags emptied into the well to go on with. Where bags are not used and the coal is bulked, whitewash splashed over the coal in the front of the tender will enable the inspector to assure himself that the weighed coal has not been interfered with during his absence. Instructions were left with the night staff to give special attention to the fire, which was to be level and well burned through by the time that the engine was booked to leave the shed. As the round trip only amounted to 109½ train-miles—110 engine-miles—it was not necessary either to clean the fire or to empty the ashpan at the half-way terminal, this being done only at the conclusion of the trial, the ash being put on one side to cool before weighing. Arrangements were always made with the traffic department to make up as far as possible a standard loading of the train when leaving the terminal points by the use of dummy wagons loaded with a known weight of coal or sleepers. It was found, however, that while the loading on the outward trip could easily be controlled, the loading inward was bound to vary on account of the vagaries of the local banana and orange export trade. It was fortunate that the loading on the outward trip could be regulated, seeing that any variation during the ascent of a 1 in 30 gradient—mentioned later—would have a tremendous effect on the coal consumption. The average of four trips can be considered as covering the vagaries of the loads on the homeward run. It is to be added that these trains were always mixed passenger and goods, roughly in the proportion of one-third and two-thirds, and were fitted throughout with the air brake, and that the weather could generally be depended on not to vary in any noticeable degree. On one occasion, however, an unusual and strong wind sprang up, and the trial was cancelled in consequence, it being considered of the utmost importance that the conditions of wind and weather should always be similar. Anyone who has watched the fireman working the same train across the Fen country here—where there is no protection whatever from the wind—under conditions of calm and in a strong side wind, will realise the importance of this point.

The details of the engine employed on these trials were as under:—Class, 4–8–0, fitted with superheater; cylinders, 19in. by 26in.; driving wheels, 46in. diameter on tread; steam pressure, 190 lb. per square inch; weight of engine and tender in working order, 108 tons 10 cwt., engine compensated throughout; heating surface, 1788 square feet, including 390 square feet of superheater surface, fitted with a rocking grate and a spark arrester. The road included gradients against the down train of 9 miles of 1 in 30, with many curves of up to 18 deg., 3½ miles of 1 in 60, and 4 miles of 1 in 100; and against the up train, 5 miles of 1 in 100, the remainder being comparatively level.

The duties of the inspector accompanying the trip, in addition to writing up the necessary data, were to see that while the pressure was well maintained the safety valves were not allowed to lift, and that no fire cleaning or ashpan emptying occurred *en route*. He also would write a report on the smokelessness or otherwise of the coal, and also on its tendency to be thrown back partially or unconsumed on to the train when the 1 in 30 bank was being negotiated.

Analysing the figures for the Welsh coal, it will be seen that the ton-miles were in excess on the third day, causing a reduction in the consumption per ton-mile, but a heavy increase in the pounds per train-mile; the reason why the pounds per train-mile happen to be included is because previous trials gave this figure only; the inaccuracy was, however, carefully explained at the time. The ash on the first day was accidentally removed before weighing, and the writer has reason to be doubtful of the figures for the second day's percentage; but he can vouch for the third and fourth days' amount, as he was present at the checking. Examining the remaining two trials, the same phenomenon due to increase of ton-miles in the consumption per ton-mile and per train-mile appears. The writer again doubts the accuracy of the ash percentage on the second day of the New River test.

It would appear from these figures that the only useful consumption figure is that per ton-mile, the vagaries of the train-mile figures being abundantly apparent. It was found that the Welsh gave the best results as to smoke and the throwing-out of partially consumed particles of fuel; the New River being a special offender as regards smoking when the regulator was closed and also the most troublesome in respect of throwing, which is a serious matter, as the coaches are fitted with end doors and open platforms, in the style of early American vehicles, and passengers are in consequence peculiarly liable to annoyance from the rain of cinders.

There is another side to coal testing that would repay investigation, and about which there does not seem to be much knowledge. The most economical cruising speeds of warships and of mercantile vessels are well known to those in authority, but is the same knowledge available concerning the locomotive classes on a railway, and, if known, is it acted upon to any extent? There must be a definite speed at which any given design of locomotive gives the best output for its consumption, which may be referred to as its "critical speed," and which can only be determined by experiment. It is realised that the principle cannot be applied indiscriminately; but it seems certain that a material quantity of coal—and water—might be saved if trains, and especially goods trains, were timed with an eye to the critical speed of the engine to be employed.

The combination of these two tests should have a useful effect on design and on the reduction of the numbers of classes of engines, by directing attention to the heavier coal burners and to those less economical at the standard speeds desired.

Welsh Coal.

Trip	Coal burnt, lb.	Total ton-miles.	Pounds per ton-mile.
First	5,500	21,408·75	0·257
Second	5,500	21,396·75	0·257
Third	5,720	25,220	0·223
Fourth	5,280	22,354·5	0·231

Average consumption per ton-mile, 0·242 lb.

Coal burnt per train-mile (109½ miles)—

	lb.		lb.
First trip	50·2	Second trip	50·2
Third trip	52·2	Fourth trip	48·2

Average of above 50·2 lb. per train-mile.

Percentage of ash—

First trip	Not taken	Second trip	46·4
Third trip	9·9	Fourth trip	10·5

Pocahontas Coal.

Trip.	Coal burnt, lb.	Total ton-miles.	Pounds per ton-mile.
First	6,600	21,369	0·309
Second	6,160	21,435	0·287
Third	7,040	28,798·25	0·244
Fourth	6,930	28,260·5	0·245

Average consumption per ton-mile, 0·271 lb.

Coal burnt per train-mile (109½ miles)—

	lb.		lb.
First trip	60·27	Second trip	56·25
Third trip	64·63	Fourth trip	63·3

Average of above, 61·0 lb. per train mile.

Percentage of ash—

First trip	9·24	Second trip	10·5
Third trip	7·8	Fourth trip	7·7

New River Coal.

Trip.	Coal burnt, lb.	Total ton-miles.	Pounds per ton-mile.
First	7,538	25,947·8	0·29
Second	7,920	27,682·9	0·286
Third	6,220	26,229·5	0·237
Fourth	7,920	33,803·25	0·234

Average consumption per ton-mile, 0·264 lb.

Coal burnt per train-mile (109½ miles)—

	lb.		lb.
First trip	68·8	Second trip	72·3
Third trip	56·8	Fourth trip	72·3

Average of above, 67·5 lb. per train-mile.

Percentage of ash—

First trip	9·7	Second trip	6·6
Third trip	10·2	Fourth trip	12·5

Alfred Dock, Birkenhead—Dock Gate Machinery.

THE Mersey Docks and Harbour Board has recently completed the construction of a new 80ft. river entrance lock, leading from the Mersey to the Alfred Dock, on a site formerly occupied by two smaller locks, and adjoining the existing 100ft. lock. In addition to the new river entrance lock a new inner 80ft. passage is also being provided between the Alfred Dock and the large enclosed water space known as the Great Float—see Fig. 1.

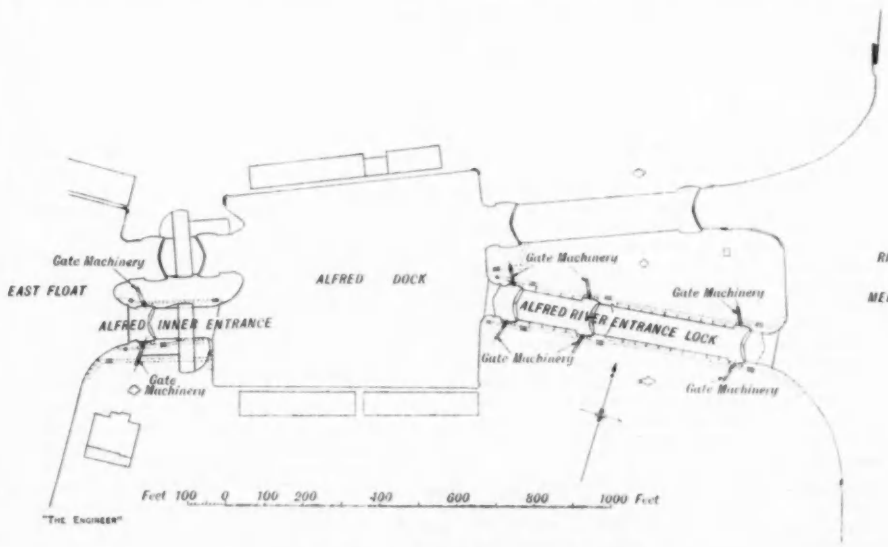


FIG. 1—THE ALFRED DOCK, BIRKENHEAD

The following brief description of the hydraulic machinery which operates the three pairs of dock gates in the river entrance lock, and the single pair of gates in the new inner passage, may be of interest. The machinery has been made to the designs and drawings of the Mersey Docks and Harbour Board, the contract for the supply and erection of it being entrusted to the Hydraulic Engineering Company, Ltd., of Chester.

There are various methods of operating dock gates; the usual practice is by means of opening and closing chains passing across the lock. With this method, the effective depth over the sill is reduced by the chains crossing the lock, and there is also slack chain to pay out or take in,

with consequent loss of time and increase in power used. Another method of operation is to couple the operating machine to the gate by a connecting-rod at or about cope level, in which case the effort is not applied at or near the centre of gravity of the forces to be overcome when moving the gate.

The feature of the arrangement at Alfred Dock is the application of the power required to operate the gate at a point corresponding, actually or closely, to the centre of gravity of the resisting forces when the gate is in motion,

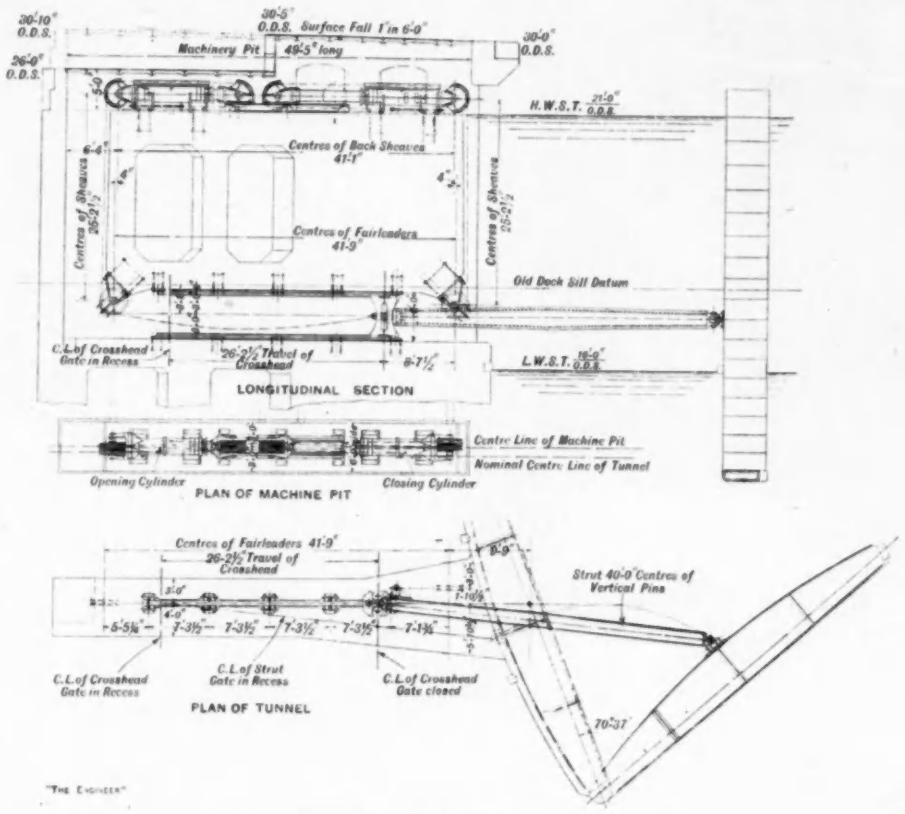


FIG. 2—ARRANGEMENT OF DOCK GATE MACHINERY

while the operating machinery is situated above the water level. In achieving this object, the arrangement eliminates the objectionable features of the other arrangements and possesses other advantages. The same system was adopted for operating the entrance gates of the Gladstone Dock, for which the Hydraulic Engineering Company, Ltd., also made the machinery.

A reference to the drawing—Fig. 2—shows the arrangement quite clearly. At the ground level for each leaf a pair of hydraulic cylinders is arranged, back to back, having chain sheaves with a multiplying power of 4 to 1. One cylinder is for opening and one for closing the leaf. At the level at which pressure is applied to each gate, which is about 26ft. 6in. below ground level, there is a recess in the lock wall for carrying a strut, one end of which is attached to the gate, the other end being supported and guided in the recess by a crosshead working in guides fixed to the sides of the recess. This strut is actuated by two chains—one of which is attached to the back and the other to the front of the crosshead—which are led down over fairleader sheaves from the cylinders on the upper level and are actuated by the rams for moving the crosshead backwards and forwards in the recess.

The rams are 16in. diameter and have a stroke of 7ft. 5in. in the case of the machines for the inner gates and 7ft. for the outer gates. They are of cast iron and work in cylinders which are also of cast iron, and they are shown in detail in Fig. 3. It will be seen that greenheart troughs and aprons are provided above and below the cylinders to prevent the chains from rubbing the cylinders and masonry. The rams are guided throughout their entire stroke by Z section guides which have renewable rubbing strips. The struts are built up of steel plates and angles, riveted together, and are absolutely watertight, all the plating work being carefully caulked and subjected to an internal hydraulic test to insure this. Each strut is about 40ft. long and weighs about 7½ tons.

The valves for operating the cylinders are of the double-ported type, so that when one cylinder is opened to pressure, the other cylinder operating the same leaf is, at the same time, opened to exhaust. The gear may be arranged so that the gates can be operated from either side of the lock.

When any repairs or renewals are required to the machinery in the strut recess, the gate is brought back to the wall and a watertight joint is made between timbers let into the wall and timbers on the back of the gate. The recess is then pumped dry, and the gear is accessible.

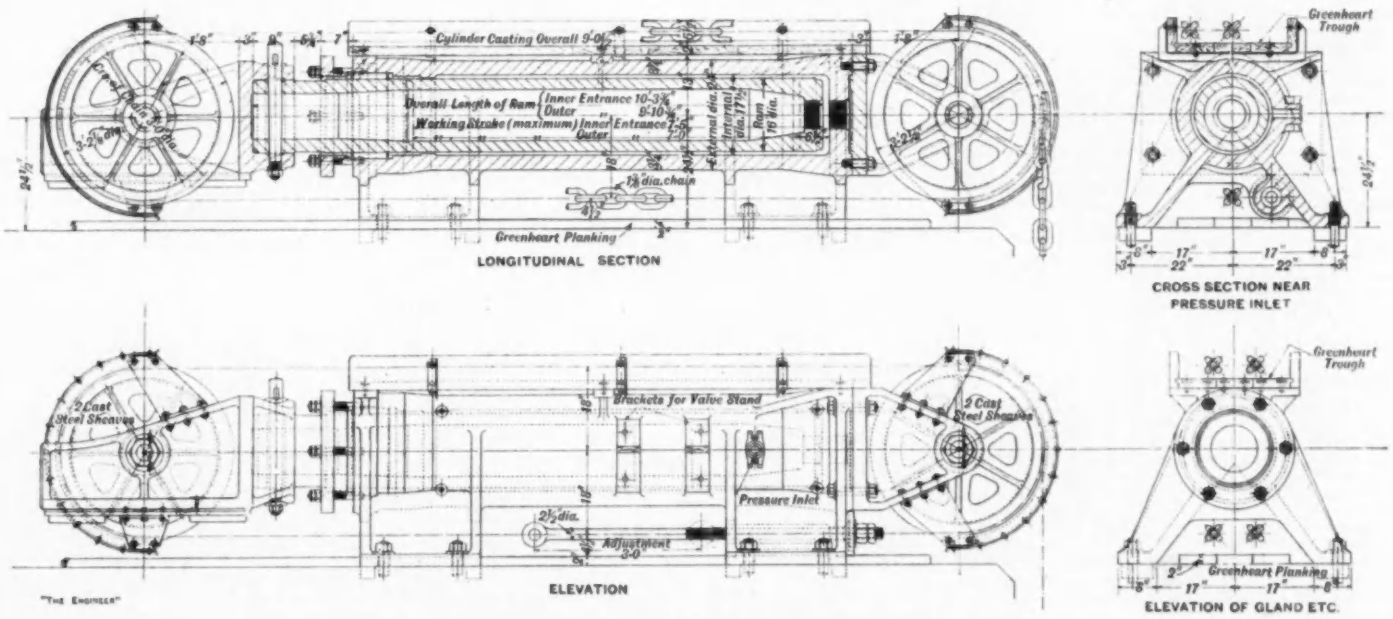


FIG. 3—OPERATING CYLINDERS AND RAMS

THE new enlarged station at Epsom, at the junction between the Sutton and Raynes Park lines, will be opened on March 3rd, and the existing station on the Sutton line—Epsom Town—will be closed. The stations at Ludgate Hill and Merton Abbey will be dispensed with on the same day.

American Engineering News.

A New Electric Furnace.

A high-frequency electric induction furnace built recently by the Ajax Electrothermic Company, of Trenton, can melt a charge of 600 lb. in about an hour. The current is supplied by a 150-kVA motor generator set in which the current is transformed from 60 cycles to 960 cycles. This current is then passed through a helical copper coil which surrounds the chamber containing the charge of cold metal. Electromagnetic currents are set up, causing heating and melting, the speed of melting depending upon the character of the charge and of the steel to be produced. In trial runs 600 lb. of pig iron and muck bar have been melted in fifty to fifty-five minutes. There is no contact between the heating element or coil and the charge, the action being entirely by induction. The container or pot for the charge is either a monolithic crucible or a lining rammed around a core; acid, basic or neutral refractories may be used. A crucible can be used for forty to fifty heats. Although the temperature of the molten metal is about 3000 deg. Fah., the shell of the furnace is only warm and there is little radiation of heat, even when the cover is removed for adding alloys to the bath. The bath has also a uniform temperature throughout. There are advantages in that the steel is made in the absence of oxygen, as well as of sulphur and phosphorus from fuels, while there is entire absence of contact with carbon electrodes. Uniformity of analyses indicates that with this furnace there is close control over all the chemical elements contained in the steel, the production of steels of special composition being thus facilitated.

Open-hearth Furnace Practice.

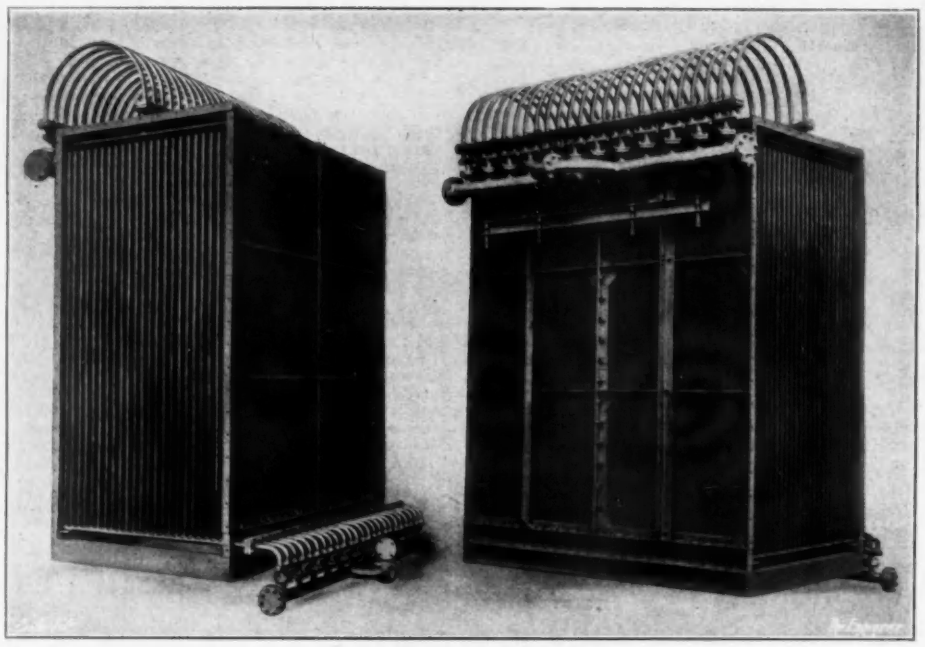
At a recent meeting of mill managers and superintendents the cracking of ingots, which appears to occur but rarely with bottom-poured ingots, uneven heating, slag inclusions and thin-skinned ingots were suggested as causes, but in one case the trouble has been stopped by increasing the corner radius of the mould from 2¼in. to 4in. Corrugated moulds which have only a very slight taper have also been successful. Titanium gives a cleansing effect as the gases work quickly through the molten steel, but it must be used with judgment, and a slight excess is likely to cause a thin-skinned ingot, resulting in cracks when the ingot is rolled. Aluminium and Spiegeleisen are used for the same purposes, and generally with success, though in some cases it has been necessary to go back to the use of titanium. Another cause of cracking is the teeming of ingots at too high a temperature, which results in blow-holes at or near the surface. These blow-holes are very sensitive to the soaking pit gases, so that the ingot will cut badly on the surface. The use of a graphite wash in the moulds may help to avoid cracks in low-carbon steel, but has little, if any, effect with rail steel. In making special steels of 0·20 to 0·30 carbon, 0·7 to 1 manganese, and 0·10 to 0·15 sulphur, there is often an excessive amount of piping in the ingots. At one mill the sound billets are only 70 per cent. of the ingot, while with steels of more ordinary composition they are from 85 to 88 per cent. of the ingot. Keeping the tops of the ingots clean by means of thorough killing of the steel is found to reduce the amount of piping.

Special Steel for Airships.

Although the tonnage of steel for airship manufacture is not large, a very high quality of metal is required, with high strength and value per unit of weight to ensure lightness, high quality to ensure reliability, and also ease of fabrication. It is generally considered that while good commercial steel may be utilised, it is better to have steel of specially high quality to develop standards of performance and reliability. Hard-drawn wire has the highest strength-weight factor. In heat-treated alloy steels the figure is about the same as in some light alloys, but the latter have a greater bulk. In particular a high degree of cleanness of the steel is essential, but it is difficult to meet this requirement regularly with open-hearth furnaces unless some changes are made in mill practice. For this

AIR HEATING BATTERIES FOR 275 LB. STEAM PRESSURE

THE VICTORIA TUBE CO., LTD., GREAT BRIDGE, STAFFS., ENGINEERS



reason there is a trend toward steel made in electric furnaces. Corrosion is an important problem, especially for craft operating over or near the sea, but protective coverings may reduce the difficulty. Metal propellers are generally made of a forged aluminium alloy having 4·5 per cent. copper, 0·75 manganese, 0·75 silicon and 94 per cent. aluminium. They do not chip and split like wood propellers when operating in snow and sleet, but they are subject to fatigue and require special attention to the surface finish. Steel propellers have not been used to any large extent in the United States. Steel construction is based generally on seamless tubing with welded joints. For welded parts a chromium-molybdenum steel is favoured. Stainless steels offer promising possibilities, but it is desirable to reduce the great number of special steels and alloys in the interest of uniformity and economy.

Locomotive Repairs by Programme.

At the Readville works of the New York, New Haven and Hartford Railroad, where large numbers of engines are handled, the repair work is programmed or planned on a schedule covering a certain period, which lists the engines to be overhauled and the work to be done on them, with the dates the engines will be delivered at the shops, and the approximate number of hours required for the repairs. This schedule also assigns to each engine a definite position in the shop for each day of the work. The shop is operated on two eight-hour shifts daily, the second and smaller shift taking care of emergency work or of repairs that require more time than was estimated. In this irregularities are smoothed out and the schedule can be maintained with little variation. The main shop is divided into four sections. Section A has places for six engines having heavy repairs to boilers and frames. Section B places for six engines with lighter repairs. Section C has twelve places for engines forwarded from A or B, but each engine is moved forward each day and cannot remain in this section more than four days. Section D has places for only two engines, and these two are run out into the yard at night, allowing a forward move throughout the shop. The engines are taken off their wheels before entering and are handled entirely by overhead cranes until ready to leave Section C, where they are replaced on the wheels. With this progressive arrangement each part of the work is performed in the same place, thus facilitating the distribution of material.

Turbo-generator of 110,000 kW.

A steam turbine generator set of 110,000 kW capacity has been put in operation at the plant of the Brooklyn Edison Company. The Westinghouse cross-compound turbine is designed for 400 lb. steam pressure, 700 deg. total temperature and two stages of feed heating. Steam is supplied by four Babcock and Wilcox water-tube boilers with 23,830 square feet of heating surface and economisers having an effective surface of 14,960 square feet. Mechanical stokers of the underfeed type deliver the coal upon a chain-grate which does not travel but has a wave motion that gradually feeds the coal forward until it falls from the grate to a clinker grinder pit. In this pit no cast iron is used, the front wall being of hard-burned paving brick with a water spray over it. The furnaces have water jacket walls on three sides, while the front wall is faced with carborundum. Air and gas pressure and volume are controlled by forced draught and induced draught fans by means of movable guide vanes in the fan inlets. This power unit can carry 110,000 kW when consuming 1,200,000,000 B.Th.U., with 27½in. vacuum. Stainless steel was used for the turbine blades, permitting the use of larger blades and higher tip speed owing to the higher permissible stress. The condenser is of the single-pass radial-flow type with an area of 85,000 square feet. It has 14,400 tubes, ⅞in. in diameter and 26ft. long. Circulating water is supplied by two motor-driven pumps, each having a capacity of 67,500 gallons per minute. Steam is delivered to the turbine through five admission valves.

Air Heating Batteries for 275 lb. Steam Pressure.

In our issue of August 1st, 1924, we published a description of the "Weldex" patented air heating battery, as made by the Victoria Tube Company, Ltd., of Great Bridge, Staffs. This type of air heater has been installed in connection with air-conditioning apparatus for large buildings, such as theatres, cinemas, banks, insurance offices and the like, and it has also been extensively employed for industrial purposes, such as drying, heating, steam removal, &c., in mills, factories, and other works. On the present occasion we illustrate a modification of the design which has been evolved to comply with some unusually onerous working conditions in connection with a special manufacturing process.

Before proceeding to do so, however, it might be desirable briefly to recapitulate the principles of the construction of the standard design. Where steam is the heating medium, the heater consists of a number of sets of vertical heating tubes arranged between a pair of top and bottom headers to form a grid, or section, The heating tubes are connected to the lower header tubes by means of stamped spigoted caps, the spigot being welded to the header and the cap to the heating tube. A passage is formed through the spigot and the cap to provide an outlet for the condensate. For the connection of the heating tube to the upper header tube, a special form of expansion bend of small diameter tube is employed, all junctions again being welded. The various sections, each containing one row of tubes, are coupled up to steam and drain manifold pipes, having welded branches by means of a screwed union, and these joints are the only screwed portions in the whole battery.

The complete battery is enclosed in a galvanised sheet casing in which provision is made for the vertical movement of the headers brought about by expansion and contraction when the apparatus is in operation. In practice it is found, we understand, that on starting up batteries working with steam from 50 lb. to 100 lb. pressure, heating tubes of about 8ft. in height will spring as much as ⅜in. out of line until the temperature becomes uniform, when they will recover their normal position. The "Weldex" design provision is made to counteract the effects of this tendency for the heating tubes to bend. The expanding connection to the upper, and the spigot connection to the lower header, are made of small cross-section, so that they may spring and prevent any undue stress reaching the welded junction, and thus prevent leakage.

The special type of heater which is illustrated herewith was made with a definite guaranteed capacity of 25,000 cubic feet of free air per minute to be raised to a temperature of 270 deg. Fah. when using steam at 275 lb. pressure per square inch, superheated to a temperature of 650 deg. Fah. The amount of expansion and contraction that the heaters are called upon to undertake when heated up and down from cold to the full working temperature is about 1 1/16 in.

In the standard design the steam supply from the manifold pipe leads directly into the end of the upper headers of the sections which project through the casing by means of horizontal branch pipes in a manner similar to that shown for the drain connections in the illustration. In view of the exceptional flexibility required to meet the special circumstances in the high temperature heater illustrated, the design was carried out as follows:—The ends of the upper headers, instead of projecting through the casing are left within it, and are quite free to move in any direction. A vertical branch pipe for the steam supply is welded to the centre of each header, and it projects through the casing. At the point where the branch pipe passes through the casing, floating airtight sealing plates are provided. They are free to move laterally within limits, and that facility enables each section to take up its natural position when under steam without imposing any stress on the branch pipes. For coupling up these branch pipes to the steam manifold, which is carried in brackets at the side of the battery, inverted U bends of large radius are employed. They are said to provide ample movement of the heater sections without putting any appreciable stress upon the connections.

All external steam connections are flanged, the flanges being welded on. Each pair of heating sections is coupled together and provided with valves for temperature control. These valves, which are fitted between the circular flanges connecting up to the manifold, are not shown in the engravings, which are reproduced from photographs taken when the battery was under test at the makers' works.

The individual sections are subjected to a hydraulic test of 1250 lb. per square inch, and the completed batteries to 750 lb. per square inch, which pressure was, in the case of the batteries we are discussing, maintained for a period of twenty-four hours.

In this particular case, owing to the fact that the air which would pass through the heater would not be clean, provision had to be made for easily cleaning the tubes, which were liable to get covered with dust. For this purpose the side and top of the casing are so arranged that they can be easily taken down without interfering with any steam joints, thumb screws being used for the angle flanges of the panels in the place of bolts and nuts. Moreover, the heaters being carried on platforms some distance above floor level, the bottom of the casing can be removed without difficulty. In this way access to the tubes is obtained, and as the sections are spaced at 4in. centres, they can easily be brushed down for cleaning purposes. It is also arranged that any individual section can be taken out of the battery, without interefering with any other section.

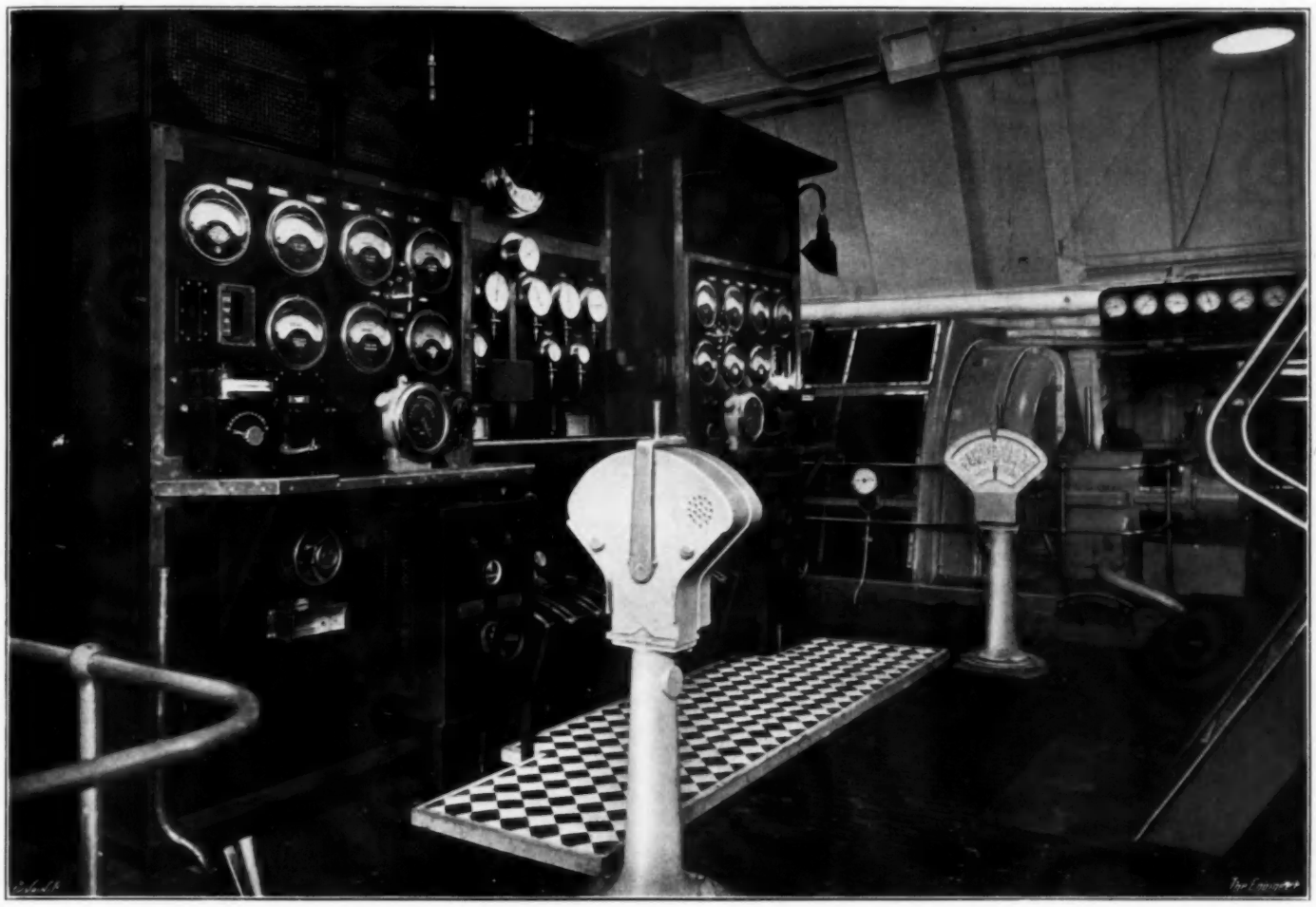
The makers point out that, though superheated steam was used in this particular instance, it is a disadvantage to use superheated rather than saturated steam, since the rate of transmission of heat from superheated steam to air is lower than from saturated steam. It is therefore necessary, when superheat is present, to provide more heating surface than for saturated steam to bring about a given heating effect, or alternatively to install a de-superheater. For the installation described in the foregoing it was considered preferable to provide the additional heating surface.

The Cornish Engine.

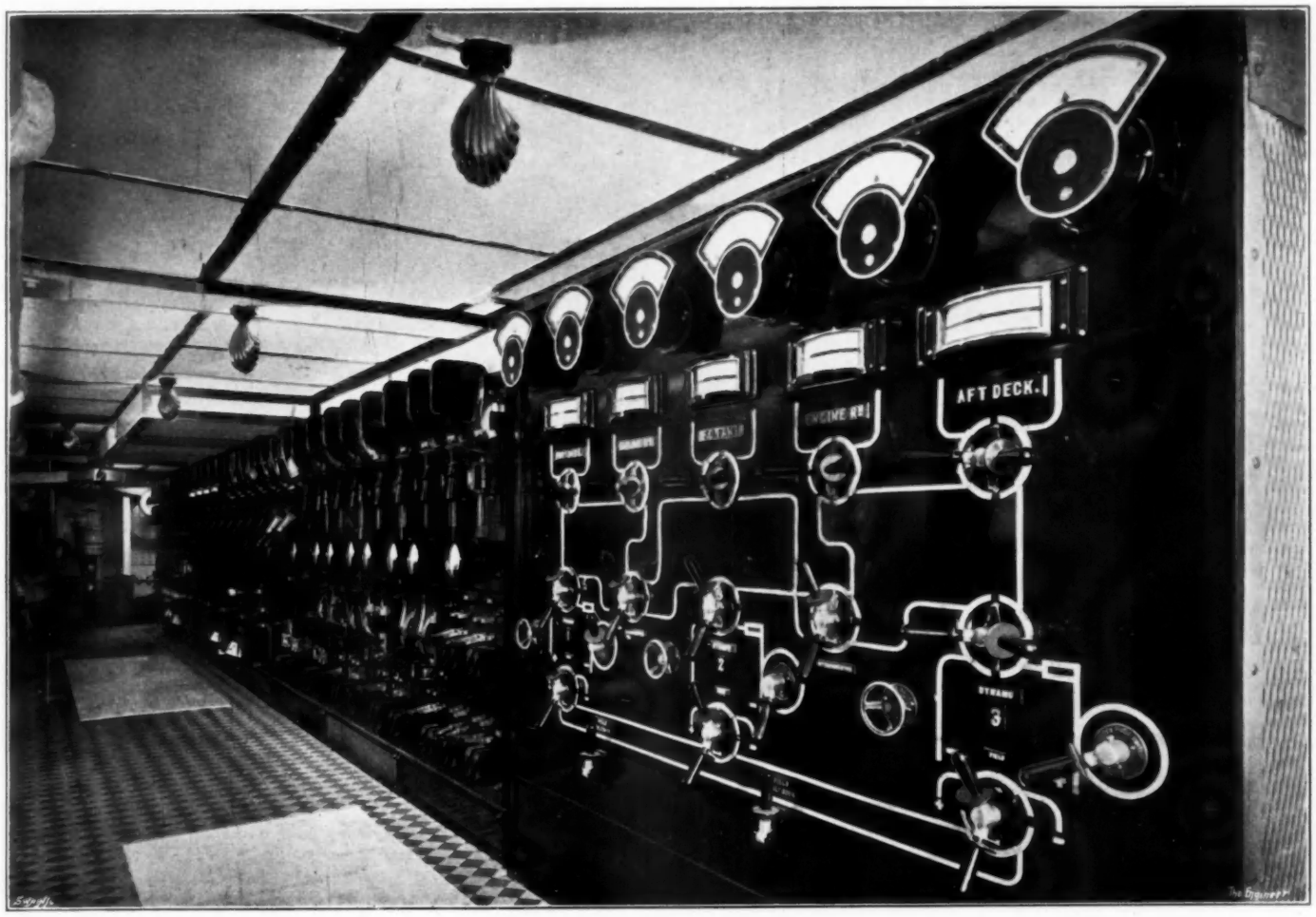
TRIBUTE was paid to the Cornish pumping engine in a lecture given by Mr. W. T. Hooper, of Falmouth, at a meeting of the Cornish Institute of Engineers on Friday, February 22nd, on "Perran Foundry and Its Productions." Mr. Hooper said his object was to stimulate a greater interest in the study and preservation of records and information relating to Cornish engineers, engines and foundries. Purely mining history had always attracted the attention it deserved, and recently a monumental work on the Cornish miner, had been published in which the story of the miner had been told in the fullest and most interesting style. There now remained to be told the story of the Cornish giant which had made mining in the county possible. That was the Cornish pumping engine, one of man's grandest and noblest achievements, which was still unsurpassed for mine drainage under such conditions as prevailed in the Duchy. The old order changed and gave place to new, and much as they regretted the fact when an abundant supply of electricity became available, the last beam engine would cease its labours and close a chapter which began with the first Newcomen engine erected in the county. Fortunately they had with them engineers eminent in their profession who were steeped in information concerning the pumping engine, and posterity would bless that Institute if it could persuade those engineers to leave a record of that knowledge and information in the shape of a book dealing with the Cornish pumping engine from 1800 to the present time. There were also many engine drivers in the mining district who had spent their lives in the mines, men who were intelligent and whose reminiscences were often extremely interesting and well worth recording. Of recent years James Watt had had full justice done to him in a splendidly written book on "James Watt and the Steam Engine," and it was now up to the Cornish engineers to produce a book dealing with the Cornish pumping engine.

Till the expiration of the Boulton and Watt patent the steam engine was crude and inefficient; their monopoly had arrested development and progress. Within thirty-four years of their departure from Cornwall the energy and ability of the Cornish engineers had raised the duty or efficiency of the engine from Watt's maximum of 20,000,000 up to 120,000,000, or about sixfold. This remarkable result was due to the labours of a famous school of engineers, all of whom were of Cornish descent or birth. The names of Hornblower, Trevithick, Vivian, Lean, Grose, Woolf, Sims, Hocking, Loam, Mitchell and Eustace were still household words. This great improvement in power and efficiency resulted in a great development of the mines, to such an extent that by 1838 nearly 300 engines were at work in the county, the majority being pumping engines.

There was reason to believe that most of these engines were made at Hayle or Perran Foundry, the latter supplying most of the machinery for the Gwennap mines and eastern district. The lecturer traced the history of the foundry founded by Mr. Robert Were Fox, senior, Mr. John Williams and others in 1791, capable of supplying all the machinery required for the Gwennap mines, and dealt with its growth until the Gwennap mines ceased operations in 1879. Perran Foundry also figured in marine work, and about 1866 four or five steamers were engined for Captain Philip Thomas, of Falmouth. Mr. Hooper suggested that the Cornish Institute of Engineers might consider the permanent marking of the site of such engines as Newcomen's first and second engine; Smeaton's engine at Wheal Busy; James Watt's first, second and third engine; the Wheal Towan engine; the Frances shaft of the United Mines, which was sunk 200 fathoms in nine months; the site of Hornblower's compound engine; Taylor's engine, &c. Taylor's engine, which was built by the Perran Foundry Company in 1840 for the United Mines, was designed by Messrs. Hocking and Loam, the eminent Cornish mining engineers. The fame of this engine was due to it having performed the highest duty



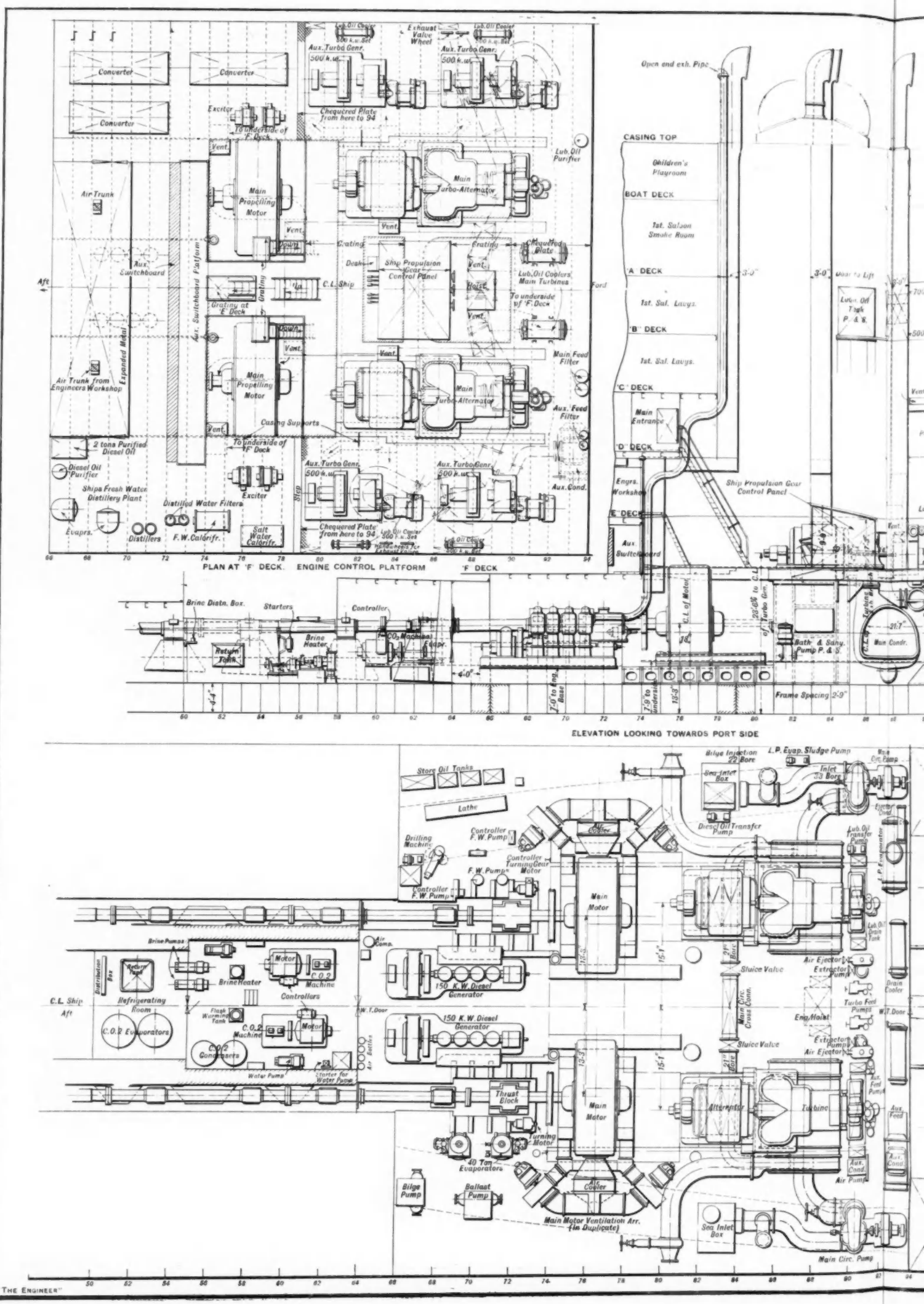
STARTING PLATFORM AND CONTROL PANELS



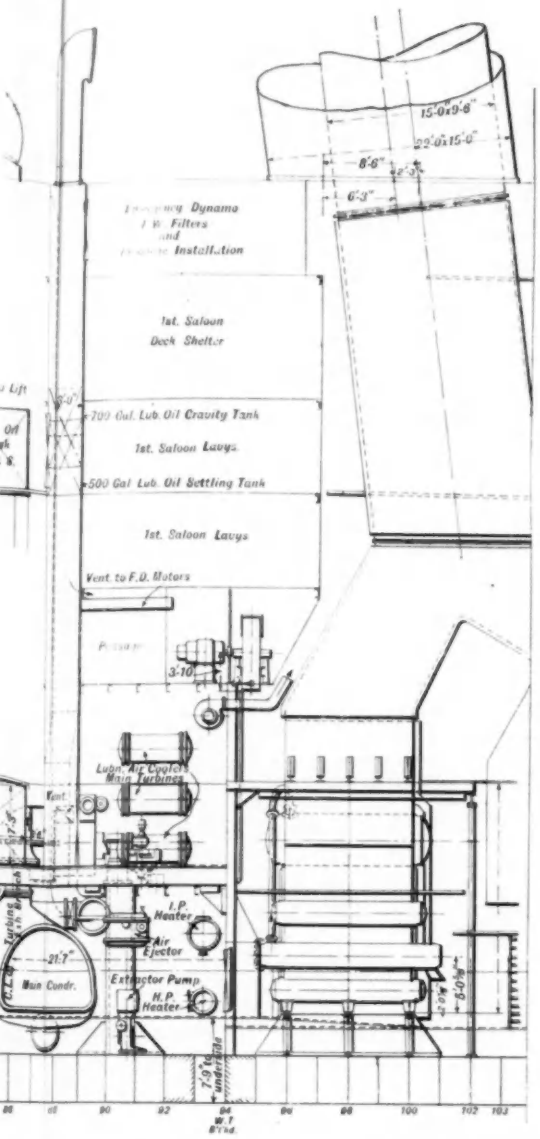
AUXILIARY SWITCHBOARD PLATFORM

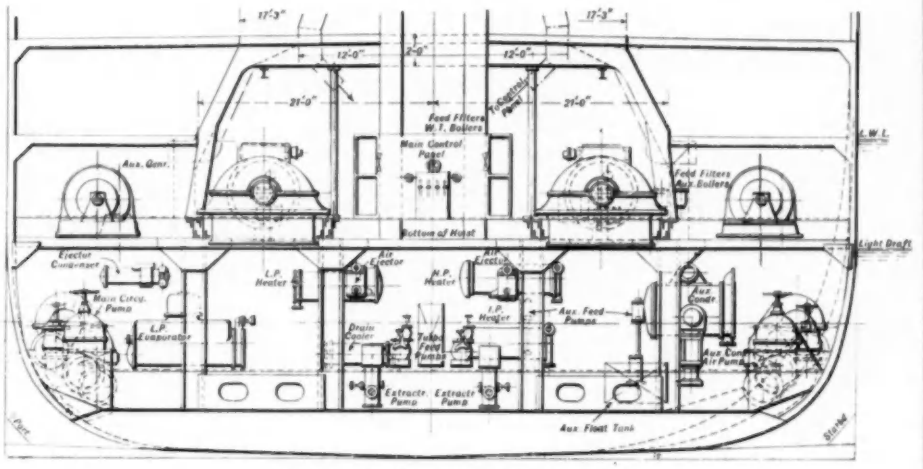
UNIV. OF MICH.

P. AND O. TURBO-ELECTRIC LINER "VICEROY"

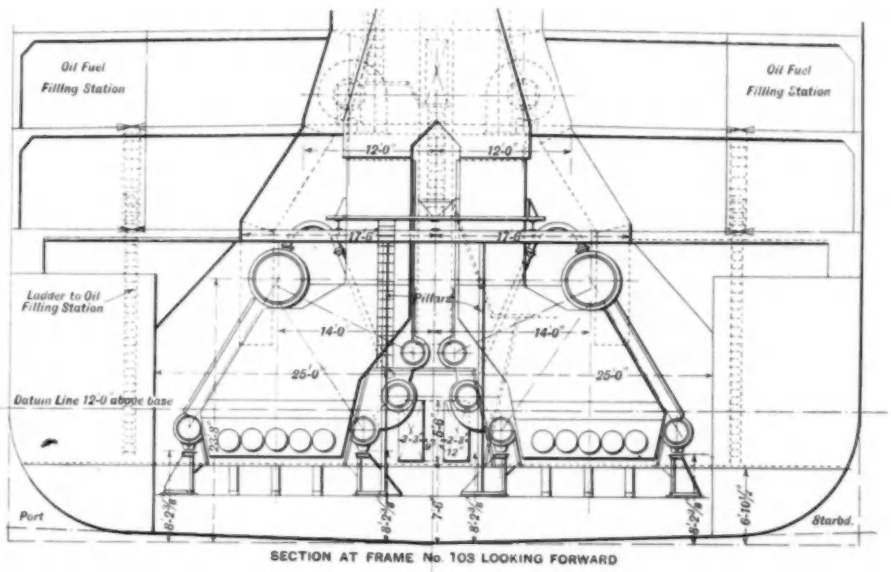


CEROY OF INDIA"—PROPELLING MACHINERY

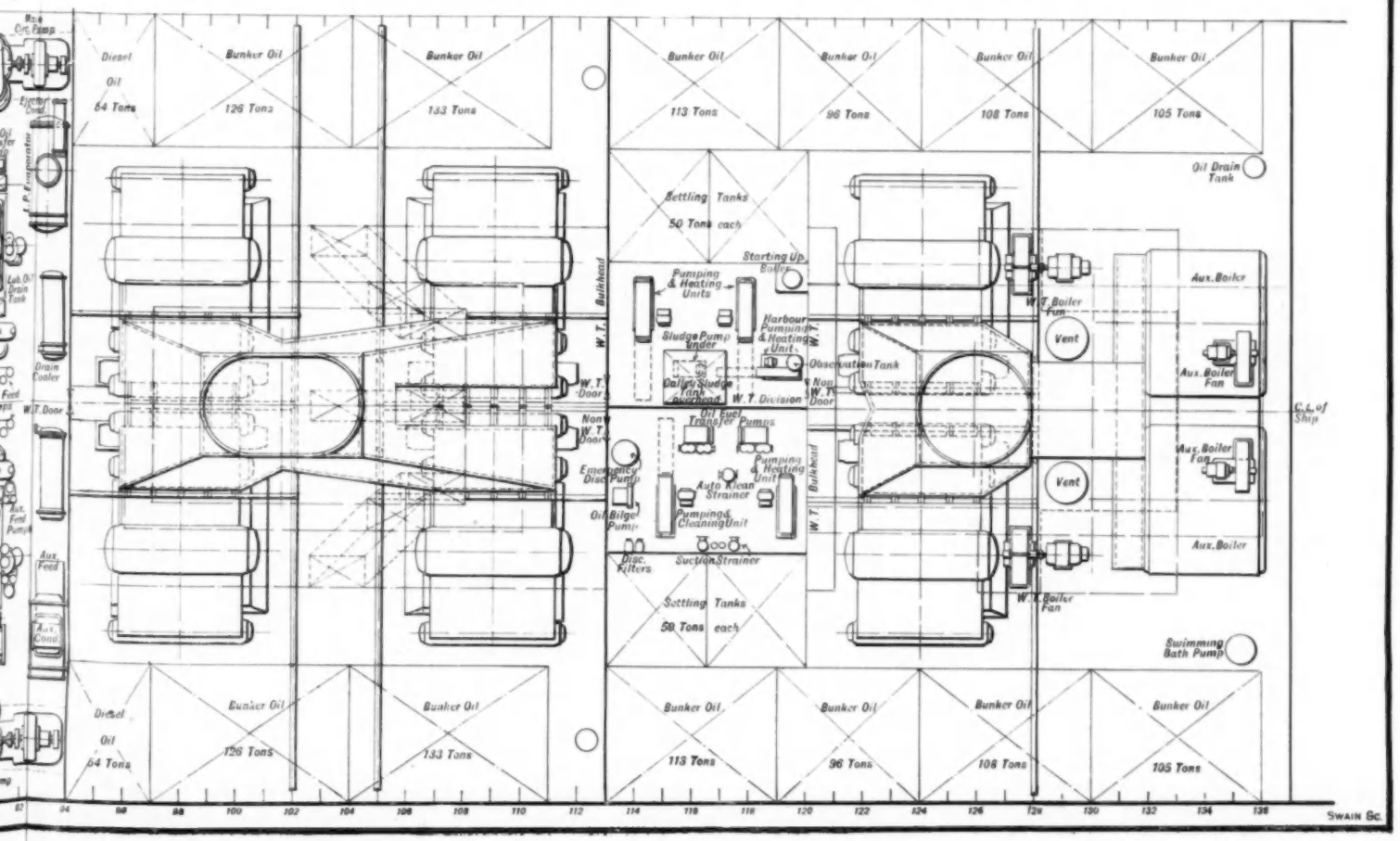




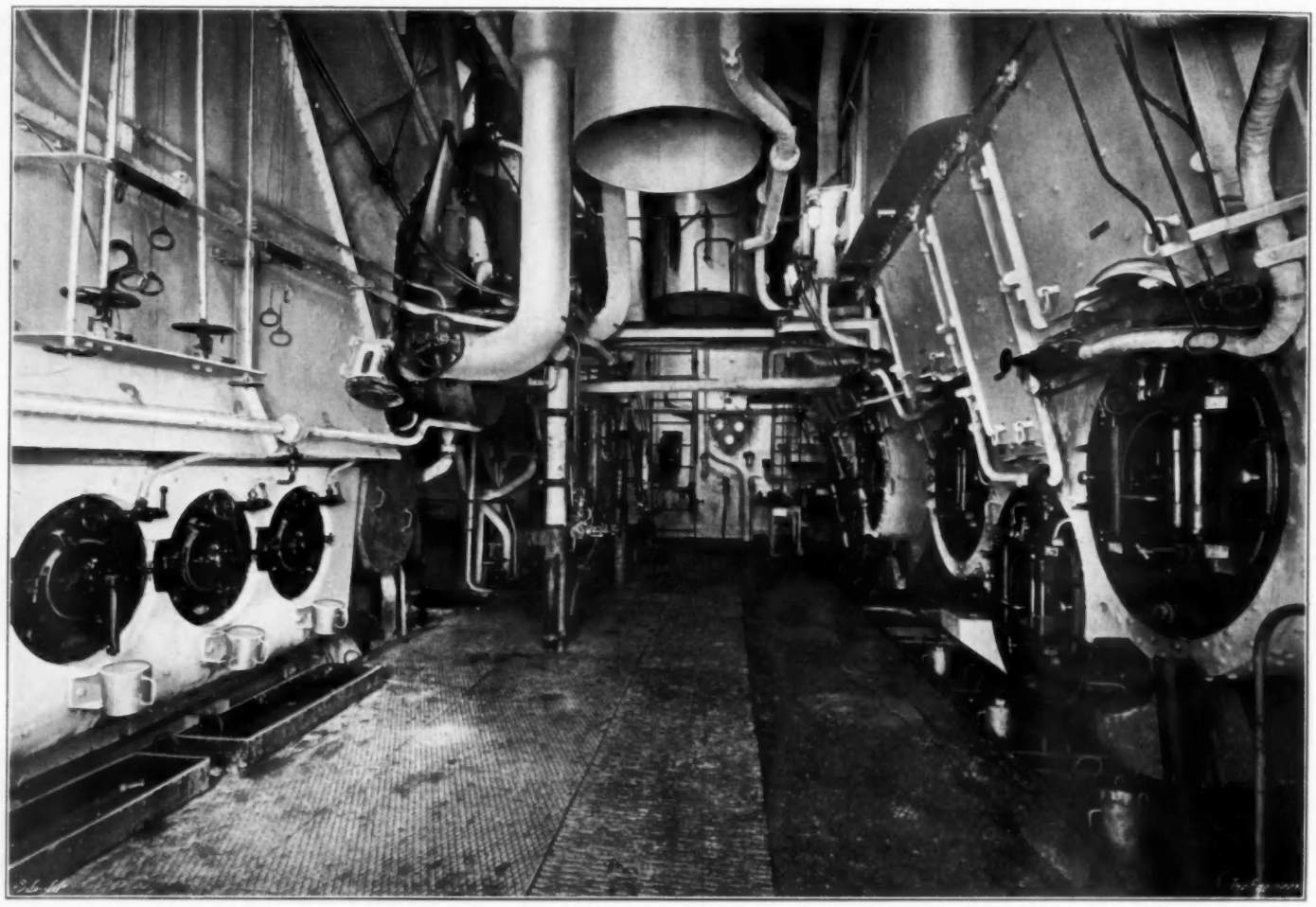
SECTION AT FRAME No. 89 LOOKING FORWARD



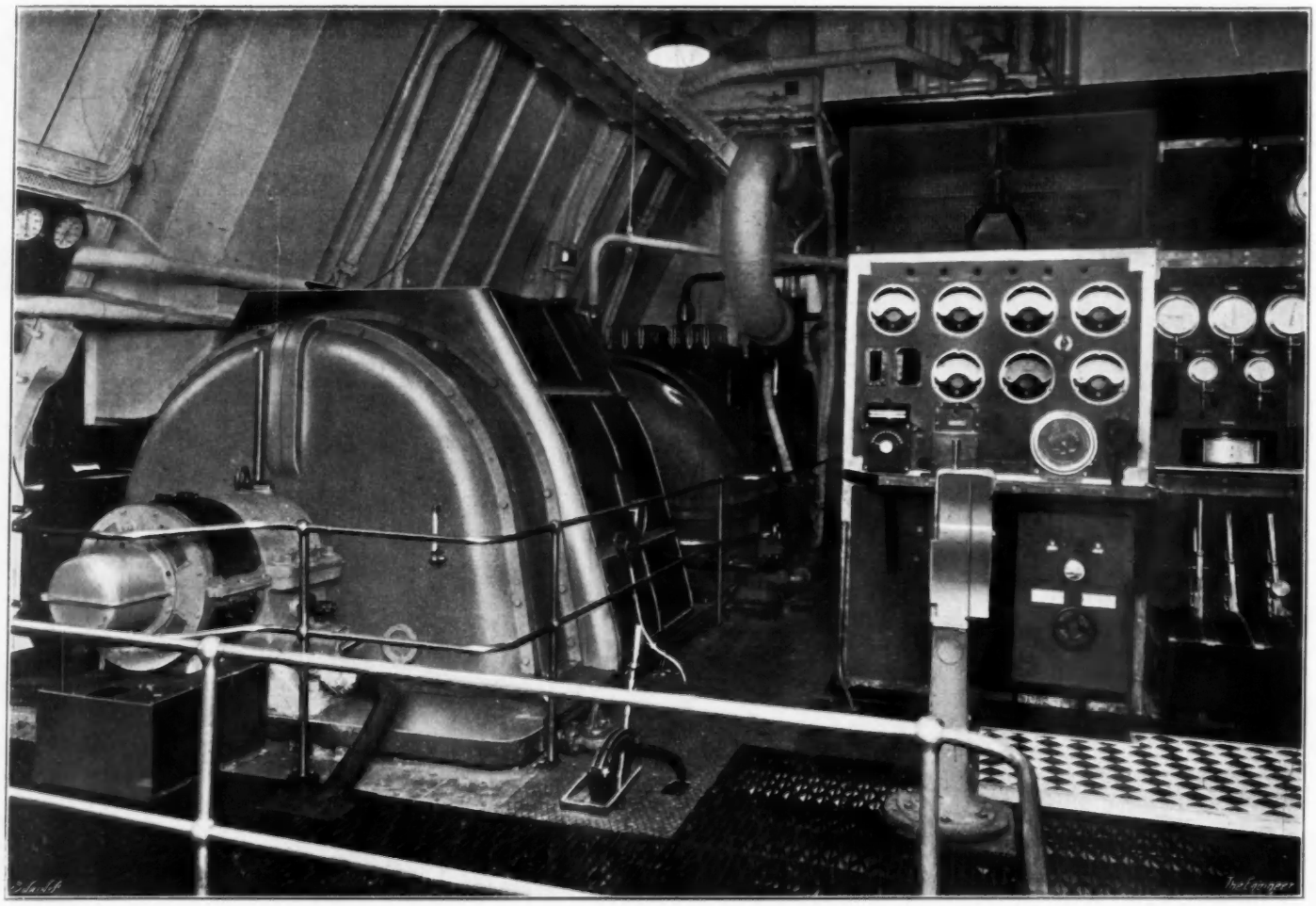
SECTION AT FRAME No. 103 LOOKING FORWARD



P. AND O. TURBO-ELECTRIC LINER "VICERO



THE FORWARD BOILER-ROOM



PORT TURBO-ALTERNATOR SET AND CONTROL PANEL

over a long period of any engine ever erected in the county. The Perran Foundry enjoyed a world-wide reputation for its production of mining machinery, and to it the Royal Polytechnic Society owed its inception.

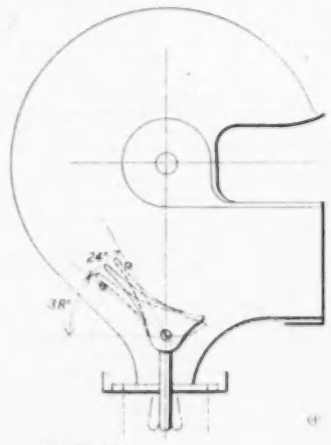
Air and Oil Filters for Oil Engines.

A VERY handy and effective little device for cleansing the air used by internal combustion engines, which has recently been brought out by Simms Motor Units, Ltd., of Gresse-street, Rathbone-place, London, W. 1, is illustrated by the half-tone engraving and sketch below.

The apparatus, it will be seen, works on the centrifugal principle. That is to say, the air is sucked into the engine round a curved path, and the dust is consequently projected towards the periphery, while the clean air hugs the inner curve of the path. Towards the bottom of the casing there is a more or less triangular deflector, which divides the air passage into two sections. In this way the

THE SIMMS AIR FILTER

dust-laden air near the periphery is definitely separated from the clean air, and is deflected downward into a little glass container which depends from the metal casing. The container has no outlet except at the top, so that the air, after deflection, returns to rejoin the main air current going to the engine. In the interval, however, the sudden change in direction has projected the dust into the glass container, where it is trapped. In order to assist this action, the walls of the container are wiped over with a little oil, or a small quantity of oil is placed in its bowl. This oil entraps very light dust, but is unnecessary for the elimination of more gritty particles. The container, by the way, is of Pyrex glass, so that it is practically unbreakable, and is held in place by a very simple spring clip. As a consequence, it can be easily cleaned out while the engine is running. The deflector, it will be noticed, is adjustable through a slight angle, in order to make the cleaner adaptable to several

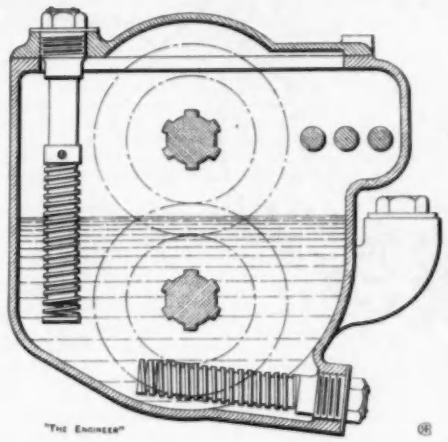


AIR FILTER SHOWING ADJUSTABLE DEFLECTOR

sizes of engine. With a large engine the velocity of the air is high and the centrifugal action is intensified, so that a comparatively small amount of dirty air need be sliced off by the deflector. With a smaller engine the reverse is naturally the case.

The utility of this device on engines working in many conditions, such as agricultural tractors drawing ploughs and cars running on dusty roads, needs no emphasis. The makers inform us that laboratory tests have shown that it has an efficiency of from 95 to 98 per cent. in the extraction of fine road dust screened through 32-mesh gauge, while we have subjected it to several tests, with satisfactory results. One of these was with some fine dust swept up off the floor of a joiner's shop, which contained a large proportion of light fluffy particles. In this case a clean visiting card placed in a large box on the outlet side of the cleaner did not show the least sign of soiling after the cleaner had been dealing with the dust-laden atmosphere for several minutes, although the box was of ample dimensions to allow dust to precipitate out, if any escaped the cleaner.

For the purpose of extraction from the oil used to lubricate gear-boxes any small particles of steel or iron which may wear off the wheels and other parts of the mechanism, and thus prevent these particles in assisting in the abrasion of the rubbing surfaces, the same company has devised a very simple little device which we also illustrate. It embodies a chrome-cobalt magnet, which is said to retain its magnetism for about forty years. Round this magnet there is wrapped a helix of mild steel, square-section bar. The helix is held in place by a stud on the magnet, over which it is screwed. The object of the helix is, of course, to provide a number of corners which concentrate the magnetic lines of force and encourage the collection of ferrous particles, while the grooves harbour them and prevent them being washed away again by the oil. When the device has been in service some time, it is a simple matter to screw off the helix, when the retaining peg



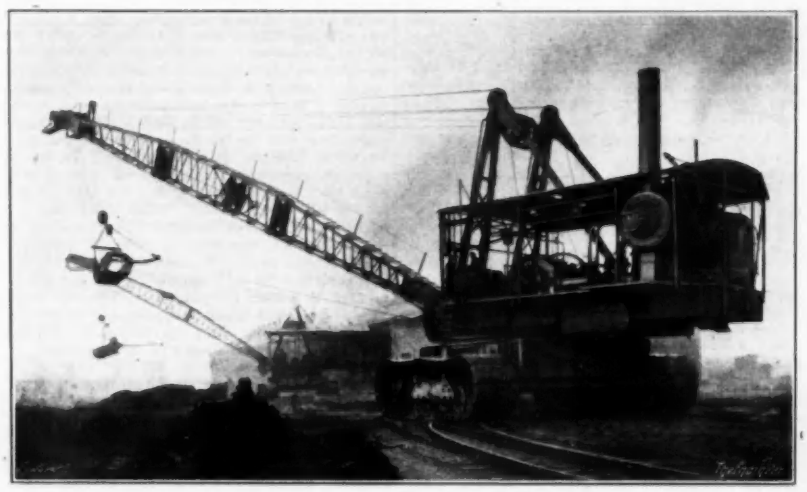
GEAR-BOX WITH MAGNETIC SEPARATORS

scrapes off most of the adherent particles, and as the helix looses its magnetic qualities immediately it is removed from the magnet, it is easy to wash it quite clean.

The illustration which we reproduce shows how simply the device can be fitted in any of the plug holes usually provided on gear-boxes.

Dragline Excavators for India.

THE photograph which we reproduce below illustrates two dragline excavators which have recently been supplied by Ruston and Hornsby, Ltd., of Lincoln, for the Damodar irrigation project in India. These two machines are very similar in design, but one of them has a 100ft. jib, while that of the other is 60ft. long. The 100ft. jib can also be extended to 115ft. by the addition of an extra piece in the centre of its length. It will be noticed that both the jibs are of the hog backed style, so that the horizontal



SELF-PROPELLING DRAGLINE EXCAVATORS

thrust tends to relieve the binding caused by their own deadweight.

The machines are mounted on caterpillar tracks, which are of such a size that the pressure on the ground is no more than 3500 lb. per square foot with the jib swung out at right angles and carrying a full load. Each caterpillar track is 4ft. 6in. wide by 20ft. axle centre. The total weight of the larger machine is 240 tons, and it is equipped with a 3 cubic yard bucket. When, however, the extended jib is in service a 2½ cubic yard bucket is used. The maximum depth to which the machine will dig with the long jib is 50ft., while it will dump the spoil to a height of 40ft. The main engine has two cylinders, 10½in. in diameter by 12in. stroke, and will develop 152 B.H.P. when supplied with steam at 125 lb. pressure, and running at 200 revolutions per minute. The slewing engine has cylinders 8in. by 8in., and gives 90 horse-power. The exhaust steam from the main engine is passed through a feed-water heater, and the feed is supplied by a Weir pump. An injector is also fitted. There is a 3-kilovolt auxiliary lighting set and a little steam-driven winch for hoisting coal on to the footplate. The travelling speed is 0·2 mile per hour. All the gears for this purpose are totally enclosed.

The site where these machines are to work is about 97 miles from Calcutta, and the headworks of the canal, which will be 13¼ miles long, are accessible by broad gauge railway. One machine will be employed wholly on canal excavation. The cutting varies from 7ft. to 38ft. or 40ft. deep. The bed width will be 55ft., and the side slopes 1 to 1. Where the cutting exceeds 15ft. deep there will be intermediate berms 15ft. wide. The maximum width of cutting will be 160ft. for a length of about 4000 running feet, where it will be 38ft. to 40ft. deep. The spoil banks will be 15ft. clear at the top of the cutting, and their slopes 1½ to 1. As the deep cutting forms a small proportion of the whole work, doubling handling of the spoil will be permitted, and the extensible jib will then be used. Spoil banks 20ft. high, with slopes 1½ to 1 and about 150ft. wide on either bank will be required at the deep cutting. A portion of the spoil to be excavated from the canal consists of very hard kunkar clay, while the remainder is hard clay. The buckets are designed to deal with this soil, which, it is believed, has not so far been excavated in India by any existing machines.

Another section of the work consists of excavation of the foundations of the weirs and under sluices, the material to be excavated being a very coarse sand, and a portion of the excavation will be in the wet below subsoil level, and for this purpose a special sand bucket will be supplied. The width of this excavation is about 250ft., and the depth to be excavated is 11ft. maximum, but generally much less than this. One of the machines is to be equipped with a navvy bucket for cutting through some high ridges of land which traverse the canal alignment in the first mile.

SIXTY YEARS AGO.

IN our issue of February 26th, 1869, we noted that a Belgian firm had recently sought tenders for the construction of twenty boilers, 13ft. long by 3ft. 6in. in diameter, with hemispherical ends and a flanged dome ring at the centre, 2ft. in diameter and 8in. high. The boilers were to be made of half-inch plate and were to be *welded throughout* to the complete exclusion of rivets. No English house, we recorded, would undertake the work, and it had in the end been entrusted to a Belgian firm. If the work were well done, we added, it would be a triumph of boiler engineering which, we regretted, would not be achieved by an English house. . . . In the same issue we discussed the running away of engines and the manner in which it might be prevented. We apparently wrote feelingly on the subject, for recently, it seems, the engine printing this journal had run away because of a failure of the governors to act. The breakage of the crank and connecting-rod followed, and as a consequence the publication of more than half that week's issue was delayed for thirteen hours. We recalled three or four instances of the running away of a locomotive. Thanks to the telegraph, the line in each instance had been cleared in time to prevent damage being done, and after a short run and a hot pursuit by another engine, the runaway was stopped. The running away of marine engines, when the propeller came out of the water, was counteracted by the use of a governor. But sometimes the governor failed to fulfil its duty, and screw shafts were broken, and, it might be, as in the case of the unfortunate "Hibernia," vessel and crew were lost. The worst of all runaways was that which sometimes occurred with stationary engines. We gave particulars of two recent instances besides our own. At a northern spinning mill, the machinery was driven by a pair of splendid beam engines that were the pride of the district. The governor was driven by a pair of light cog wheels from the main shaft. One fine day one of these wheels broke, the governor balls dropped, the throttle valve flew open, and the engines ran away. Before the driver could stop them the engines were wrecked, the fly-wheel split, the entablatures and columns torn up, and the ends knocked out of the cylinders. At another mill the engine had run away and smashed itself to pieces as a result of another governor failure. The loss was estimated at from £6000 to £7000, and 700 hands had been thrown out of employment. The remedy for such mishaps was, we said, simple, namely, the use of a double beat equilibrium throttle valve and by arranging the governor in such a way that when the balls were close down to the central spindle, the throttle valve would be closed. We trusted that in future the use of such safety governors, as they might be called, would be the rule rather than the exception in stationary engines.

JAPANESE HYDRO-ELECTRIC POWER PLANTS

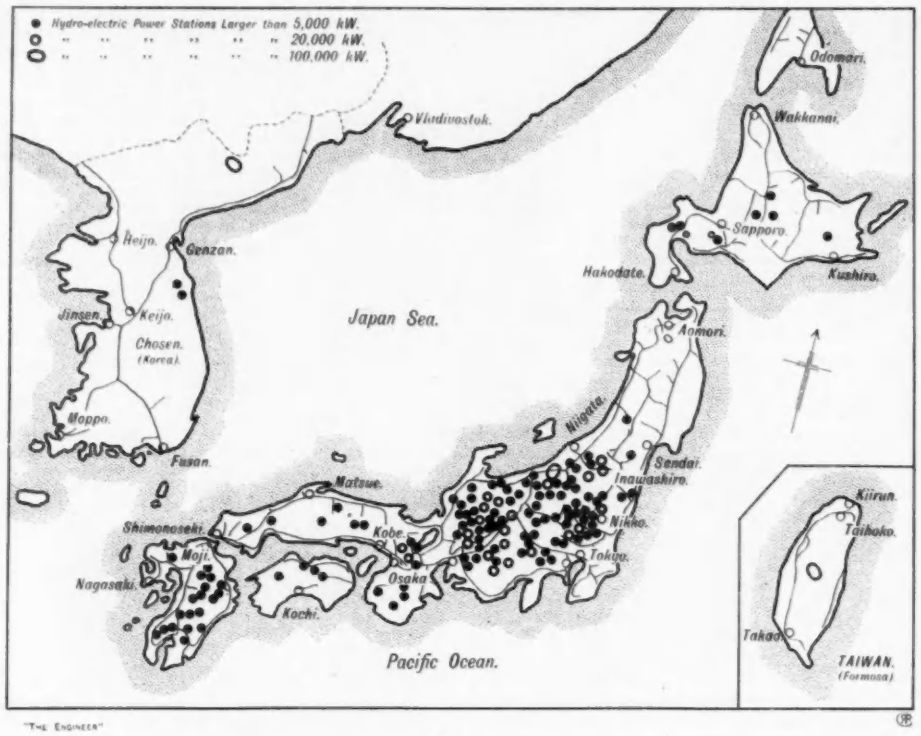


FIG. 1

Development of Hydro-Electric Works in Japan.

By S. TANABE.

THE construction of the Kyoto Municipal Hydro-electric Works of the Lake Biwa Canal* in 1891, marked the beginning of an epoch not only in Japan. At that time 220 volt and 500 volt continuous currents were employed for the distribution of electricity for lighting and power near the power station, and 2000 volts alternating-current for distant electric lighting.

In 1898 an hydro-electric power station supplied light and power to the City of Hiroshima, 13 miles distant, by an 11,000 volts transmission line.

From 1905 the progress became very rapid on account

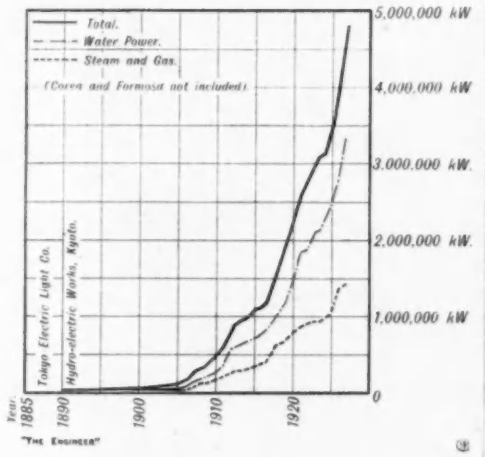


FIG. 2—OUTPUT CURVES

of the increase of demand and the adoption of high voltage transmission.

In 1912 a second Lake Biwa Canal was completed and the pioneer power station was enlarged. In 1915 Inawashiro water power plant transmitted energy by an 115,000 volt air line to Tokyo, a distance of 140 miles.

As shown in Fig. 1 and 2 hydro-electric works are making notable progress in Japan. At the end of March, 1927, there were more than one hundred hydro-electric power stations larger than 5000 kW, and including those to be completed in the near future, there will shortly be installed over three million kW, which is about one-third of the total economic available power in Japan :—

	Water power. kW.	Steam and other. kW.	Total. kW.
Completed ..	1,965,970 ..	1,236,644 ..	3,202,614
In construction	1,426,611 ..	222,438 ..	1,649,049
Total	3,392,581 ..	1,459,082 ..	4,851,663

The length of line conductors, including those for electric railways, is 135,236 lineal miles, with an aggregate length of 442,649 miles ; and in the year 1926 the total output was 9,091,211,608 kWh, of which water power accounted for 89 per cent., steam for 10·9 per cent., and gas for 0·1 per cent.

In the above figures Formosa and Corea are not included. In Formosa, out of a total 25,000 kW, about two-thirds are generated by water power. The construction of a big water power plant of 140,000 H.P. was begun some years ago, but on account of the economic condition, the work was postponed, but is now in process toward revival. In Corea, out of a total output of 35,000 kW, only one-fourth is now produced by water power, but a large water power station of 120,900 kW is approaching completion in North Corea.

* Min. Proc. Inst. of Civil Engineers, Vol. CXVII., Part 3, 1893–4.

South African Engineering Notes.

Witbank Power Station.

THE demands from the Rand Gold Mines, from municipalities on the Rand, and also from industrial concerns, are increasing so rapidly that a fourth 20,000 kW set is being commissioned at the Witbank power station in the Transvaal. Just before Christmas it was stated that the set could be given steam for turning round, drying out and testing in two or three weeks if necessary. Certain auxiliary gear under sub-contract was, however, not in the same forward state, and a considerable amount of work had still to be done in erecting three additional 70,000 lb. boilers. It was quite time the station was given a greater capacity, as on a recent visit it was noted that each unit was generating 20,500 kW, giving a total of 61,500 kW continuously. The local load is growing at such a rate—several collieries having been connected up recently—that the fifth 20,000 kW set, for which the station was designed, will have to be ordered soon. Witbank is definitely limited to 100,000 kW by the water factor. Allowing for two dry years, the Oliphants River cannot be relied upon to supply the water for condensing purposes for more than the five 20,000 kW sets, and it is the only important source in the district.

American Interest in Rhodesia.

American capitalists are investing money in the base metal undertakings in Northern Rhodesia on a scale that bids fair to give them the control of most of them before long. American copper companies are particularly keen on obtaining shares, the object, of course, being to retain the control of copper. Unless the judgment of all groups, in the best position and best qualified to judge, is in error, the creation in Northern Rhodesia ultimately of a copper-producing capacity of 200,000 tons or more per annum seems already within the range of probability. The production of the Roan Antelope Mine and of Bwana M'Kubiwa, including N'Kana, is expected to amount to well over 125,000 tons per annum within six or seven years. Two big mines on the N'Changa deposit also seem assured, and it is understood that discoveries made within the N'Kana Concession are giving every promise of still other big mines. American firms have already obtained the control of the Roan Antelope with its 30,000,000 tons of copper ore already developed, and the other day they secured a huge block of Bwana M'Kubwa shares. The latest development in Northern Rhodesia shows that American interests are steadily pursuing their policy of gaining control. The flotation of a large finance company, in connection with North Rhodesia mining developments, is imminent. The cash capital will run into millions. The Anglo-American Corporation of South Africa (to a great extent an American concern), and the Chartered Company will be the largest shareholders. Their representation on the board of directors will include Sir Ernest Oppenheimer, who will be chairman, and Sir Henry Birchenough (President of the Chartered Company). Other participants include a leading American mining group (copper), and a prominent Rand house. Not only are British capitalists and mining interests losing the control of the base metal concerns in Northern Rhodesia but it will mean that American plant and machinery will be bought instead of British, and Americans will constitute the management and technical staffs. This has already come to pass with regard to the Roan Antelope copper mine.

Johannesburg's New Railway Station.

Preliminary work, estimated to cost £280,000, on the new Johannesburg Railway Station, is now practically completed, and a start on the building of the rest of the station, for which a provision of £360,000 is made, is to be made in the near future. The greater portion of this sum will be devoted to the main building, of which, corner stones were laid by the Minister of Railways and Harbours on December 10th. Two years ago work on the new station, was started, and rapid progress has been made on what proved to be a heavy task. The milk depôt has already been completed. Before it could be constructed, the old native compound and quarters had to be removed, and the motor subway, which passes under the building, had to be constructed up to the transformer house on the island platforms. The lowering of the tracks from Twist-street Bridge to the island platform to give the necessary clearance under the bridge and to provide for a platform uniformly 2½ft. above rail level is nearly finished.

£1,000,000,000 of Gold.

With the declaration of the November output the value of the gold production of the Union passed the thousand million sterling mark. No country owes a greater debt to science than does South Africa, for it has only been by the exercise of technical skill of the highest order that the difficult problems associated with the winning of the gold have been solved. Science and enterprise have been combined in the building up of one of the world's most notable industries. Directly and indirectly the gold mines have made an immense contribution to the well being of the country. As yet the mines continue to maintain and even to surpass the great production achieved in recent years, and the loss of the outputs of several mines, which have nearly exhausted their ore bodies and must soon close down, will be fully made up for by new ones which are being opened up. Within a few years, however, a number of mines will come to the end of their lives, and, so far, new ones to replace them have not been found. Still, there are possibilities in certain parts of the Rand field, and with further improvements in mining practice, and sympathetic consideration of its problems by the State, the gold mining industry should continue to be important and prosperous for another quarter of a century, at any rate.

Harbour Works Progress.

Up to the end of December, 643ft. out of the 1500ft. by which the breakwater at Cape Town is to be extended, had been completed. The blocks used weigh about 38 tons apiece, and they can be laid by the Titan crane at a radius of 115ft. In connection with the widening of the South Arm of the dock to 700ft., so that steamers can lie on both sides of it, the main wall on the new side is practically complete, save the knuckle at the end, and the filling in is proceeding. The filling in is being done by pumping out what will be the new dock, so that, while filling in behind the main wall goes on, the dock is being deepened. The Random block mole, which is to form the opposite side of the new dock, has been carried out over 2000ft., which is about half the total distance. It is not proposed to put the knuckle on it for some time to come. In order to deal with heavy weights, such as locomotive boilers, wagons, &c., tenders are being invited for a 60-ton floating crane. A system of flood lighting has been introduced in the dock area. It comprises over forty projectors, each carrying a 1000-watt lamp. Groups of these projectors are mounted on steel towers, two of which are 70ft. high and six 45ft., while others are mounted on lofty structures, such as the grain elevator. The local lighting has also been improved, and it is now possible to carry on loading and unloading by night practically as efficiently as by day. Two large two-storey cargo sheds have been erected on the South Arm and two more are to be built. The steel framework of each is estimated to weigh approximately 1000 tons. Fourteen large tanks, with a total capacity of about 15,000,000 gallons have been erected by the four principal oil companies in South Africa for the bulk supply of petrol. The total quantity of cargo handled at the Cape Town docks in 1928 was 1,719,841 tons, compared with 1,590,617 tons in 1927. The record is held by the year 1925, when 1,828,642 tons were handled. In that year, however, South Africa had a record maize crop, and 435,254 tons were shipped through Cape Town, whereas in 1928 the quantity was only 211,792 tons.

Improvements and extensions are also being made in Durban harbour. The wharf at the oil sites at Island View is at present 500ft. in length, and can take only one tanker at a time. This wharf is being extended by 1000ft., the first 500ft. of which will be completed in four months. The extension of the wharf at Congella by a further 600ft. is to be started almost immediately. Reclamation is being carried on extensively on the bay side. A scheme for reclaiming 85 acres is now being put into operation. A Titan crane has just been erected at the harbour breakwater, and when it has been tested, work will immediately begin on the extension of the breakwater.

TIN.—An instructive little book entitled "Tin. World Statistics, 1929," has just been published by the Anglo-Oriental Mining Corporation, Ltd., which initiated last year a scheme of research into the economics of tin production, one side of which is essentially concerned with statistics. The title as set out is a little misleading, for obviously there could be no statistics for 1929, but in all the tables a column is left so that they may be filled in. The earliest year covered is 1921, and most of the figures do not go further back than '24. One diagram shows that throughout the last half of 1928 production was well in excess of consumption, and another that there was a steady fall in prices after the peak had been reached at the end of 1926. The tendency is again upwards. It is noticeable that the trade was low in 1926, but has risen steadily during the past two years, with falling prices.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

No Change.

THERE is no change to record in the general state of industrial affairs in the Midlands and Staffordshire. Business continues gradually to show expansion, and consumers of iron and steel, though still buying cautiously, are inclined to act a little more freely. Especially is this the case in the raw iron department, where prices continue to go against the buyer. To-day's meeting of the iron trade in Birmingham was well attended, and a moderately good volume of business was done. Although orders are not forthcoming as rapidly as was anticipated a few weeks ago, *habitues* of the Exchange see no reasons for withdrawing the optimistic views then expressed. As long as trade continues to mend, they assert, they will be content to rely upon time and the accumulation of small orders to restore the heavy industries of this area to something akin to an healthy state.

Pig Iron Values.

The further advance of Northamptonshire pig iron prices had as its object the restoration of a more equitable relation between this brand of iron and that manufactured by Derbyshire furnacemen. The advance, which was one of 1s. 6d. more than the price fixed at the recent Conference of Midland blast-furnace owners, was stated to be in accordance with an agreed decision at a recent meeting of furnacemen. As far as can be ascertained, Derbyshire makers have offered no objection to the rise nor are they considered likely to do so. The new quotation of £2 19s. was generally named by sellers this week, but evidence is not yet conclusive that the new level will be accepted by buyers. Some consumers who for a long while have been buying from hand-to-mouth have had perforce to pay the price demanded to secure supplies urgently needed, but others with stocks are holding off the market till the new level of prices is determined. Smelters appear to have secured the whip hand, but buyers are not inclined to accept the lash without a deal of kicking. Whether they will succeed in getting over the traces has yet to be discovered. Supplies of Northamptonshire pig will within a very short time be augmented by the output of the re-kindled Gransley furnace. Production is being increased in other districts also. The foundries are absorbing more material, but there has not been time yet to test the new balance of supply and demand. Sales of Derbyshire foundry iron at £3 2s. 6d. have noticeably improved during the week. This is quite possibly due to the fact that consumers have thought it better to place business on the present basis of prices rather than wait for further increases. The only North Staffordshire producer of foundry iron is quoting £3 5s., but consumers consider this is rather a big price, and hesitate to place business. There is no longer the superabundance of hematite that formerly embarrassed the market, and values are firm. Forge irons are little called for, and the volume of business passing is insufficient to test values. Quotations of Northamptonshire brands have, however, been advanced proportionately with the rise in prices of foundry grade iron.

Finished Iron.

The effort to place values on a higher level in the Crown bar department of the Staffordshire iron trade has met with little, if any, success. Some makers maintain the higher quotations given out last week, but others have reverted to the old order of prices, finding it impossible to induce users to place business at the higher figure. Demand has certainly improved of late, but it is apparently not strong enough greatly to aid producers in their endeavours to redress, what are claimed to be, inequalities in selling prices. Staffordshire Crown bars are accordingly quoted £9 10s. to £10. Makers of Crown bars from other districts continue to offer Crown iron on this market at £9 2s. 6d. and £9 5s. per ton. The marked bar mills are doing a fair business at £12 per ton, and chain and cable makers find some improvement. Nut and bolt iron is in poor request. Belgian iron bars can be bought for about £7 5s. delivered in the Black Country. This is a high price compared with about a year ago, but it still shows a wide margin in favour of the continental material, native makers quoting £8 10s. to £8 17s. 6d. There is not much new business in continental material, however, for the Black Country consuming works are not at all well placed for business, and moreover the foreigner is not at the moment pushing business, apparently having good markets elsewhere. The bulk of the continental iron and steel material now coming into the country is for consumption at works nearer the coast. Tube makers are calling for regular supplies of strip and mill owners are happily circumstanced. Values remain at £10 12s. 6d.

Steel Billet Prices.

The stiffening tendency of prices in the semi-finished branch of the steel trade has now developed into definitely advanced quotations. On 'Change in Birmingham to-day—Thursday—the general quotation for English billets was £6 7s. 6d., a price at which many consumers bought. It was possible to get supplies of Welsh billets from some sources at £6 5s., but some sellers of these asked £6 6s. Increased selling prices also applied to small rolled bars, and a good deal of the business put through to-day was at prices nearer £8 than £7 15s. It could hardly be said, however, that the latter quotation had everywhere been withdrawn. Local rollers for the most part quoted £8 as a basis for negotiation, and varied the actual selling price according to individual circumstances. Sheet bars were quoted £6 5s., and cold rolled steel also participated to some extent in the upward movement. Continental semis are still more or less off the market, prices being too high to make their purchase by Midland manufacturers a desirable proposition. Heavy steel prices are unchanged, and demand in this branch leaves much room for betterment. It is stated this week that shipbuilding activity has brought slightly more work to the rollers of plates and sections. Constructional engineers still complain of small orders and scarcity of inquiry. An improvement in the weather would probably have a marked effect upon this department. At the moment works are held up, and few structures are being erected on account of the somewhat unusual climatic conditions prevailing throughout the country.

Galvanised Sheets.

Both home and export demand for galvanised sheets keeps up and mills are in an enviable position, having excellent order books and new business coming along almost as rapidly as orders are executed. An increasing number of manufacturers quote £13 15s. for 24-gauge corrugated sheets, but it is still possible to do business at half a-crown below this figure. Excellent trade returns are expected from this department for February. Business in tin-plate in this district is quiet and featureless.

Scrap.

The demand for heavy steel scrap is maintained, and sellers are experiencing no difficulty in getting the good price of £3 2s. 6d. for supplies delivered to South Wales. Efforts to improve on this figure, however, do not appear to have met with success. Sales of wrought iron scrap are moderately good at recent selling rates.

Foreign Competition in Wagon Building.

Railway carriage and wagon building firms in the Midlands are in a happier frame of mind than they were a year ago, for their prospects appear to be considerably improved. Last year was a very trying one for the local rolling stock establishments, foreign competition being intense and prices consequently ruling at a low level. Now, however, in at least one of the countries whence the keenest competition has emanated, manufacturers are quoting high prices, indicating increased costs of production in that country. At a recent meeting of the Birmingham Railway Carriage and Wagon Company, Ltd., Mr. Alfred R. Windle, the chairman of directors, pointed out that the rates of wages on the Continent ranged between 45 and 70 per cent. of those paid in this country, so that his company was severely handicapped when meeting competition from this source, as it had to do in all the principal markets. He stressed the importance of maintaining the greatest economy and maintaining plant in the very highest state of efficiency, which he said was the keynote of his firm's management. Referring to the prospects of the company, which last year made a profit of £88,833 available for dividend as against £98,513 the previous year—Mr. Windle said that the firm began this year under more favourable auspices than those of last year. It had a fair amount of work on hand at present, and there were indications that there might be an improved demand. The fact that some foreign competitors' prices were now approximating more nearly to its own encouraged the company to take a more hopeful view of the future.

Good Business for Engineers.

Midland engineers are extremely pleased with the manner in which business has progressed, up to the time of writing, at the Castle Bromwich branch of the British Industries Fair. The orders placed in the engineering section of the Exhibition constitute a bright feature, and are said to have been proportionately larger and better than in other departments. I am assured that during the first week of the Fair many machines for high-speed production were disposed of. The fact that many manufacturers are embarking upon large expenditure in this direction is regarded as full of promise for the future of trade.

Rolling Stock for Overseas.

Of the important contracts for rolling stock for overseas railways just received Midland firms have secured a share. The Gloucester Railway Carriage and Wagon Company, Ltd., is to supply to the Ceylon Government Railways thirteen underframes, complete with bogies. The Sentinel Wagon Works, Ltd., of Shrewsbury, is to build an articulated steam rail car for service on the Federated Malay States Railways, and two steam rail cars for the Korean (Chosen) State Railways.

Unemployment.

One result of the recent severe frost and abnormal weather has been to increase the total of unemployed persons in the Midlands by over 23,000. The latest returns show the total to be 198,666, as against 175,591 a week ago. The Birmingham figures have gone up from 26,583 to 29,197, those of Coventry from 2414 to 2611, and Wolverhampton from 6467 to 7190. Each of the principal towns in the area record an increase of varying degree. None, unfortunately, could claim a decrease..

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Results.

FURTHER particulars are now available concerning the financial results of the past year's operations of Mather and Platt, Ltd., engineers, of Newton Heath, Manchester. The net profit for 1928 of £241,520, compared with £232,946 in the previous year, shows an improvement of £8574, and after paying the preference dividend, which absorbs £20,000, and a tax-free dividend of 15 per cent. on the ordinary shares, the sum of £108,006, against £131,945 in 1927, is carried forward. The reduction in the last item is due to the fact that the amount brought forward was £131,945, compared with £164,458 in the previous year's balance sheet. At the end of 1928 there was an increase in stock in trade to £404,512 from £369,242 at the end of 1927. The directors of Willys Overland Crossley, Ltd., Manchester, have decided, out of the profit for the past year of £50,329, to recommend the payment of a dividend of 6 per cent. on the participating preferred ordinary shares, and, with the sum of £66,462 brought in from the previous balance sheet, to carry forward £80,791. No dividend is recommended on the ordinary shares. Stock-in-trade and work in progress are valued at £449,223, compared with £569,904 at the end of 1927. The directors' report states that new models, notably the Manchester commercial truck, have been successfully placed on the domestic and foreign markets during the year, and that the very considerable sum spent in initial experimental work, together with the cost of the jigs and tools necessary for production, have been debited to trading. Improved results are disclosed in the annual report of the National Gas Engine Company, Ltd., of Ashton-under-Lyne. The net profits for 1928 amount to £72,440, compared with £51,350 in the previous year, and a dividend on the ordinary shares of 7 per cent., against 5 per cent. in 1927, is recommended, the preference shareholders receiving the usual distribution. Stock-in-trade and work in progress are valued at £168,595, compared with £189,157 at the end of 1927.

Two New Oil Engines.

At the annual meeting in Manchester on Monday of this week of Crossley Brothers, Ltd., gas and oil engine manufacturers, of Openshaw, Manchester, Mr. J. J. Carter, managing director, referred to two new types of engine which had been introduced by the company. A new type of horizontal engine which was only put on the market a short time ago had, said Mr. Carter, resulted in so great a demand that for the first time since the trade depression set in, the firm had been obliged to work double shifts in the department making it. There have also been many inquiries for the new vertical engine which has just been introduced. Sir Kenneth Crossley, the chairman, said that the actual trading profits of the company, amounting during the past year to £56,813, have very nearly returned to the average of pre-war days.

A Temporary Air Port.

The Manchester Corporation Aerodrome Committee is apparently not content to wait until the completion of the municipal aerodrome at Chat Moss before an actual start is made with organised flying services, for the Committee has now evolved a scheme for providing a temporary landing-place in the neighbourhood of Wythenshawe Park, from which it is proposed to begin operations in April. Negotiations are in progress between the Corporation and a flying company, which proposes to institute Liverpool–Manchester–Croydon and Liverpool–Manchester–Hull services at an early date, in addition to a "taxi" service to various parts in this country and on the Continent. The Chat Moss aerodrome is expected to be ready for commencing operations by about August or September of this year.

Workers for the Foundry.

Speaking at the annual dinner in Manchester of the Lancashire Branch of the Institute of British Foundrymen, the President of the Institute, Mr. S. H. Russell, said that, notwithstanding the fact that they had had the sympathetic help of headmasters and teachers in secondary schools, there was an acute shortage of youths of the type likely to make good foundry foremen and works managers. The difficulty would be greatly aggravated in two years' time by the fact that the boys leaving school would be those born during the war period, and the number would be 30 per cent. fewer than at present. The opinion of Mr. E. Longden, the President of the Lancashire Branch, was that, following the example of America, development would have to be along the lines of greater use of mechanical appliances and standardisation in production.

£2250 Post for Gas Engineer.

The Manchester Gas Committee has recommended the Establishment Committee to advertise for a chief engineer for the Corporation gas department. A salary of £2250 a year, it is understood, is to be offered.

Non-ferrous Metals.

Except for tin, which has experienced a rather severe decline compared with a week ago, all sections of the non-ferrous metals have had a firmer spell. Standard brands of copper have not yet got back to the high point touched at the beginning of February, so far as cash metal is concerned, but they are not much behind at the moment of writing, whilst in the case of forward metal, current quotations are actually about £2 a ton higher than they were early in the month. The position of this section of the market continues to display considerable strength, and interest from both consumers and speculators keeps up. With regard to tin, stocks of this metal at London and Liverpool show a tendency to grow, and that factor, coupled with a cautious attitude on the part of buyers, has had a further definite weakening influence, current values for cash, foreign being about £2 10s. per ton lower on the week, with English metal 10s. to 15s. cheaper. The turnover in the case of lead has been less extensive than in the previous week, though the demand is still on a fair scale, and quotations on balance represent a rise of about 5s. a ton. Buying interest in spelter is only of moderate extent at the moment, but the undertone is steady and quotations are 5s. higher.

Iron and Steel.

Inquiry for pig iron from local consumers is on the quiet side just now so far as new orders are concerned, although delivery specifications are still reported to be on a satisfactory scale. Prices continue to display marked firmness, with Staffordshire No. 3 at 72s. 6d. per ton and Derbyshire at about 70s. 6d., both delivered Manchester. Middlesbrough iron is maintained at 80s. per ton, and Scottish at 88s. to 90s., both delivered locally. West Coast hematite iron has firmed up to 84s. 6d. per ton delivered, and demand is up to its recent level. Lancashire bar iron makers this week have advanced quotations by 10s. per ton, making Crown quality bars £10 10s. per

ton and seconds £10. This, however, is due to rising production costs, and not to any improvement in the amount of business being done. Merchant buying of constructional steel this week has been on a better scale, although constructional engineers themselves continue to operate on a hand-to-mouth basis. The movement of locomotive plates, and also general plates, is rather quiet. So far as prices are concerned, these keep firm although unchanged since last report, large steel bars offering at £8 17s. 6d., small sizes at from £8 to £8 2s. 6d., general plates at £8 12s. 6d., sections at £7 17s. 6d., and boiler plates at £9 12s. 6d. to £9 17s. 6d. per ton, according to grade. Continental steels retain their recent firmness, though there has been no important feature regarding the weight of buying operations during the past week.

BARROW-IN-FURNESS.

Hematite.

The improved tone of the hematite pig iron market continues, and customers are still inclined to buy both for present and future requirements. Stocks in the district are coming down, but it will be some time before they have completely vanished. If trade continues on the present scale, it will not be long before one or more ironworks in the West Cumberland district puts in a furnace or two. Everything points in that direction at present. Business in better qualities continues to be steady. Trade with the Continent is regular, but does not amount to a heavy tonnage. Business with America varies, but there was another dispatch from Barrow last week to Philadelphia. The general trade of the district and the prices ruling are largely affected by the East Coast competition, and prices are expected to lift and business improve when stocks are cleared in that district. That is the opinion of many on the West Coast. The outlook in the iron ore trade is better owing to the possibility of more furnaces being put into action. There is a better trade in superior qualities of local ore outside the district. The steel trade continues to be moderate, and although the steel departments at Barrow and Workington are engaged on railway material, fresh orders would be welcome. The hoop works at Barrow are busy.

Shipbuilding.

There was launched from Vickers-Armstrongs' yard at Barrow on Tuesday the Orient liner "Orontes." This is the fourth liner to be built for the Orient Company by the Barrow yard during the past few years, and is the fifth of the new fleet. She is similar to the "Orama," "Otranto," and "Orford," in many respects, but she has incorporated in her design many refinements which make for better speed, greater economy in running, and more attractive internal arrangements. She is 664ft. long and 75ft. in breadth, and has an approximate tonnage of 20,000.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trades Position.

THE most satisfactory feature of the steel trade is the continued good demand for soft basic steels, but as the greater part of the trade in the Sheffield district is concerned with high-grade material, the effect of this is not so great as might be expected. The large plants at Templeborough, however, are very busy. For ordinary competitive work the demand remains poor, the orders which are coming in being small, although numerous, and the absence of substantial orders for railway work is being severely felt. Fortunately, there is a tendency for the production of special lines to increase, and firms which have set out to meet special requirements of modern industry are fairly busy. Unemployment figures in the trade do not improve.

Contracts for Local Firms.

Amongst the important orders for railway equipment overseas which have recently been secured by British firms is one for 520 bogie wagons, which has been obtained by Cammell Laird and Co., for the Central Argentine Railway. Cammells have also obtained an Admiralty order for steel blooms, and are to build two motor tankers —one of 1200 tons deadweight—for the United Molasses Company. A War Office order for steel castings has been obtained by T. Firth and Sons, Sheffield, while Steel, Peech and Tozer, of Rotherham, have secured an Admiralty order for steel blooms.

Old Steel Firm Reconstructed.

The well-known steel firm of Jonas and Colver, Ltd., Novo Steel Works, Sheffield, which dates back to 1870, has been reconstructed under the title of Jonas and Colver (Novo), Ltd. About a year ago, as a result of losses suffered during the coal strike, the debenture holders appointed a receiver, under whose control the business was carried on until the recent announcement that Mr. S. C. Goodwin, on behalf of the Neepsend Steel and Tool Corporation, Sheffield, had concluded a contract with the receiver for the purchase of the business. The financial position of the firm is now said to be strong. During the recent difficult period work has been carried on at full strength. Operations will continue at the firm's present works at Attercliffe, Sheffield.

Lincolnshire Works Reopened.

At the Redbourne Hill Works, Lincolnshire, two open-hearth furnaces have been gassed, and the big mill, which has an output capacity of 5000 tons of rolled material per week, is to be started immediately. It will be necessary to put further melting plant into operation, so as to occupy the mill fully, and it is expected that the reopening of the works will find employment for some hundreds of men in the Scunthorpe district. Production will principally comprise tin-plate bars for the use of Thomas and Co., the South Wales tin-plate firm, which has been using foreign material whilst the Redbourne Hill Works have been closed.

Solid Forged Boiler Drums.

The use of higher steam pressure and temperatures in industry has made necessary a change in boiler construction, and there is an increasing demand for solid forged high-pressure boiler drums. Vickers-Armstrongs, Ltd., of River Don Works, Sheffield, have installed a special plant for the production of solid forged drums. Their manufacture involves the use of very large ingots, one ingot recently used weighing as much as 165 tons. Recently twenty-four boiler drums were made by Vickers-Armstrongs for Imperial Chemical Industries, Billingham, and the firm has made similar drums for the Leicester Corporation's new super-power station.

Cutlery and Plate Trades.

There has been no improvement in the cutlery and plate trades, and conditions generally are unsatisfactory. Some good business has been obtained, however, through the British Industries Fair at the White City, and local firms which have booked orders there include Thomas Ward and Sons, safety razor blades; Steel Products, Ltd., cutlery; George Butler and Co., cutlery; and P. Osborne, Ltd., cutlery.

Coal Carbonisation Plant.

The erection of a low-temperature carbonisation plant at Askern Colliery, near Doncaster, is approaching completion, and it is believed that it will be in operation by the end of March. It is planned to deal with 1500 tons of raw coal per week, and from it will be produced about 1050 tons of smokeless fuel, nearly 30,000 gallons of crude oil, 3000 gallons of motor spirit, over 6,000,000 cubic feet of gas, and a quantity of ammoniacal liquor. This plant is being installed by Low-temperature Carbonisation, Ltd., which has works at Barugh, in conjunction with Askern Coal and Iron Company, while a subsidiary company, Doncaster Coalite, Ltd., will operate it.

Villages' Electricity Scheme.

In connection with a scheme to supply electricity to Askern and the surrounding villages of Sutton, Compsall, Norton, and Moss, an agreement has been reached between the Yorkshire Electric Power Company and the Askern Coal and Iron Company for the supply of electricity in bulk from the latter firm. This arrangement will obviate the laying of long supply cables from points where the power company is already operating, and as distribution cables have already been laid in Askern, it is expected that electric light will be available there very shortly.

Spanish Duties on Steel.

The terms of a decree just issued by the Spanish Government regarding the classification of steel and rates of duty are looked upon as a triumph for the Sheffield Chamber of Commerce, since they are in agreement with the proposals made to the Government by the Chamber. The decree, which is dated February 9th, sets forth the duties for various kinds of steel, the contents of which are described in detail. Sheffield firms have suffered considerably during the past few years, owing to steel being classified on its arrival differently from the declaration made on the certificate of origin, and consignments have been placed in higher categories under the tariff than was warranted by the goods exported. The new rates now brought into force will be found to apply much more equably to the actual value of steels imported by Spain, and in view of the fact that assurances have been given that, in the new Spanish tariff, the duty rates on steel will not be advanced, it is hoped and anticipated that this present decree will form part of the new treaty in October, when the question of the new Spanish tariff comes up for revision.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THERE is quite a famine in Cleveland pig iron just now, and there is no doubt whatever that the current output is quite inadequate to the needs of industry. Some of the local firms are themselves importing iron from the Midlands to meet their own pressing needs, and some of the bigger producers of Cleveland iron have withdrawn entirely from the market, having no more iron for sale. Others are not prepared to book orders for delivery earlier than April. Thus, the ironmasters are in a very strong position; but in regard to prices they are exercising a wise restraint. As yet, only an advance of 1s. per ton has been imposed, and it is understood that the makers are not likely further to advance prices at present. Presumably their immediate objective is increased output, and some surprise has been expressed that more blast-furnaces have not already been put into commission. Supplies of ore and coke, however, are not very readily obtainable, and until these difficulties have been overcome, a largely increased output of pig iron is not possible. Meanwhile, a blast-furnace has been restarted this week at Cargo Fleet, which brings the total number in operation on the North-East Coast to thirty-six. Prices are very firm, No. 1 Cleveland foundry iron being 69s. 6d.; No. 3 G.M.B., 67s.; No. 4 foundry, 66s.; and No. 4 forge, 65s. 6d.

Hematite Pig Iron.

The shortage of supply of East Coast hematite pig iron is causing a good deal of inconvenience, and as economic conditions are changing for the better, hope is entertained that ironmasters will feel justified in the near future in increasing production by the restarting of idle blast-furnaces. Under present conditions consumers have a poor chance of getting early delivery if this has not already been arranged. There is scarcely any iron in stock, and all the current output is sold with orders now being booked for April delivery. Prices are firm, mixed numbers being quoted at 72s. 6d., and No. 1 at 73s.

Ironmaking Materials.

Imports of foreign ore under running contracts continue on a fairly substantial scale, but new business is difficult to arrange. Some of the principal holders have, in fact, withdrawn from the market, having no supplies to offer. Thus, works which have not covered their needs may soon be in a difficult position. Prices under these circumstances are a matter of arrangement, and 22s. 6d. per ton is purely a nominal figure for best Rubio ore. The coke market is characterised by increasing firmness, and 18s. is now quite a minimum price for good blast-furnace qualities, some sellers asking more.

Manufactured Iron and Steel.

Operations at the shipyards having been seriously interrupted, and in some cases suspended, owing to the wintry weather conditions, specifications for shipbuilding material have been slow in coming forward during the past two or three weeks, and the steel works have scarcely been so active. Generally, however, the steel makers are well off for orders, and prices are very firm indeed. The strength of the continental markets and the delay in deliveries of foreign material continue to divert orders to this district. The demand for semi-finished steel, such as billets, slabs, &c., has increased considerably in recent weeks, and a big output is being maintained. Good home trade seems assured and prospect of overseas business is brightening.

More Shipbuilding Orders.

Prospects of the shipbuilding industry on the North-East Coast continue to improve for the present year by the receipt of new contracts, although many more are required before all the shipyards can be fully employed. Craig, Taylor and Co., Ltd., the Stockton shipbuilders, have received an order from a Cardiff shipping firm for a vessel of 7600 tons deadweight. The engines are to be installed by Blair and Co., Ltd., marine engineers, of Stockton. Swan, Hunter and Wigham-Richardson have booked an order for two vessels of about 6500 tons each for Newcastle owners; and W. Gray and Co., Ltd., West Hartlepool, a contract for a cargo steamer of about 8500 tons. The latter vessel will be built at the firm's Wear Shipyard at Sunderland, and will be engined by the Central Marine Engine Works at West Hartlepool.

The Coal Trade.

There is a feeling that the coal trade in the North has taken a definite turn for the better, although it is recognised that the severe weather at home and abroad accounts for most of the demand at the present time. The nominal output for weeks ahead in every description is ear-marked, and in most grades the owners appear oversold, whilst there is no slackening off in the demand for eight to ten weeks ahead. The transport of Polish coal is still heavily hampered, and this is one of the chief reasons for the large inquiry for Northumberland coals. Production at the collieries is being increased by employing more men and rearranging shifts, while in Durham a few more idle pits are being restarted. In the meantime, much more coal could be sold than is at present available for prompt shipment. An encouraging feature from the owners' point of view is that prices have appreciated considerably in recent months. For instance, best Northumberland steam coals, which several months ago were down to 12s. 9d., now stand at 16s. to 16s. 3d., and even 16s. 6d., and are very difficult at these prices to obtain, owing to the increased demand. Northumberland small coals have increased in price in proportion. In Durham county, too, coking coals and gas coals of every brand have appreciated fairly substantially. Gas coals are at present at a minimum of 15s., and 15s. 3d. is easily obtainable for early cargoes. Coking coals are so well sold that there is little of them on offer for early delivery. The quotation is firm at 15s. to 13s. 6d. Supplies of bunkers are scarce, and the market is firm for superior classes at 15s. to 16s., and steady for ordinary unscreened at 14s. 6d. The pressure for all kinds of coke is strong. Gas coke is fully sold to the extent of handling facilities, and neither direct nor through contractors are supplies available until the second half of March. Prices are firm at 21s. 6d. The pressure for foundry and furnace coke is keen from all continental centres, but particularly from Germany, and makers are sold out for some weeks ahead. Prices are quoted nominal for next month. Patent cokes, 22s. 6d. to 25s.; beehive and special cokes, 25s. to 28s. 6d.

Big Steel Order.

The Whessoe Foundry, of Darlington, has secured the contract for the erection for the Shell Mex Company, Ltd., of two big tanks at Ellesmere Port, and two at Hamble, Southampton. About 24,000 tons of steel will be used in their construction.

SCOTLAND.

(From our own Correspondent.)

Business Improving Slowly.

WHILE there is a steadier flow of orders for shipbuilding materials, a continuance of which must ultimately have a beneficial effect on allied industries, business in steel and iron generally expands slowly. A little more optimism abounds in trade circles, and a firmer tone is apparent here and there, but all-round expansion is slow. Restricted outputs and abnormal weather conditions have strengthened the coal market, and a very firm level of prices has been established. With so many pits idle, however, the position is somewhat unreal.

Steel.

As has already been stated, makers of heavy steel are now receiving a more satisfactory number of

specifications for shipbuilding materials, and their mills are steadily employed. Home demands for structural material are fairly good, and the export demand improves. Raw materials have appreciated in price and there is a possibility that steel prices may be increased accordingly. Scrap materials have been scarce of late, and this has hampered outputs to some extent. Steel sheet makers are not too busy, and dearer raw materials have caused an advance in prices. Tube makers are busy, more especially in the butt welded and hot rolled branches.

Iron.

The bar iron works which suspended operations four weeks ago are still idle. One result has been to impart a firmness to prices quoted by those works still in operation. It is understood that an effort is being made by the Ministry of Labour to reopen negotiations between employers and the Iron and Steel Trades Confederation, with a view to an early settlement of the dispute. Makers of re-rolled steel report improved demands, and prices are firmly maintained at £7 15s. per ton, home or export.

Pig Iron.

Business in pig iron moves very slowly. Hematite is quoted 75s. per ton delivered at steel works, and No. 1 foundry 73s. 6d. and No. 3 foundry 71s. per ton at furnaces. It is said that the outlook for basic iron locally produced has improved a shade, and better prices are now being secured.

Exports and Imports.

Imports at Glasgow Harbour last week included 1500 tons of steel and iron from the Continent, and 2100 tons of pig iron from English ports. Shipments of steel and iron totalled 2400 tons and pig iron 1359 tons.

Boiler Orders.

It has been announced that Yarrow and Co., Ltd., of Scotstoun, Glasgow, have secured three contracts for land boilers. The Harrogate Corporation has ordered two boilers, each for 50,000 lb. per hour normal output; Brown and Adam, dyers, of Glasgow, one of similar output; and the India-rubber, Gutta-percha and Telegraph Works, Ltd., of London, three boilers each for 40,000 lb. per hour normal evaporation.

Coal.

Conditions in the Scottish coal market are unchanged. Restricted outputs and the abnormal weather have combined to create an exceedingly firm attitude. The recent pressure for supplies by foreign importers has abated, owing to the impossibility of arranging for anything but odd lots, and their unwillingness to contract ahead at present prices. It is almost a certainty that the collieries lost a considerable amount of business, owing to their inability to supply in quantity. In all districts the collieries are fully booked, and prices asked for odd lots available for shipment are easily obtained. Aggregate shipments for the past week amounted to 226,199 tons, against 153,599 tons in the preceding week, and 246,321 tons in the same week last year. It is announced that five pits in Lanarkshire will reopen this week. It is understood that the Collieries Scheme Committee in its efforts further to stabilise the industry, proposes that basic prices should be fixed for home delivery and shipment, and that when the difference between these and market prices touch a certain point, a payment per ton should be made to collieries which have sold for shipment. It is also recommended that the production quota fixed for each colliery should make provision for coal for shipment to Ireland, and that quotas and prices should be considered once a month, and, if found advisable, altered.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE firm tone of the steam coal market which has been manifest of late has been fully maintained during the past week. The position of collieries for early loading is a strong one, while for March the outlook is very favourable, and it would be no surprise if the present satisfactory conditions continued throughout April. The inquiry for prompt supplies of coal for delivery at near Mediterranean and the North French Coast and Bay ports, also at Rotterdam and Amsterdam, is still good, as a consequence of the severe weather prevailing, and the fact that the transport of continental coals is held up. Apart from this, orders held for other directions are fairly numerous, and a feature of the market is that, notwithstanding the amount of tonnage which is already waiting in dock to load and the general tightness of stems, outward rates of freight have advanced, in some cases very substantially, for the reason either that merchants have to effect delivery promptly or that they have deemed it prudent to charter and so make sure of obtaining their coals. Some collieries are now fully stemmed up with tonnage for the whole of March, which, or course, owing to the Easter holidays, will be a short working month. Actual new business of a heavy amount is not considerable at the moment, but it is the general inquiry in which there has been so much improvement. So far as contract operations are concerned, it is now confirmed that the Portuguese State Railways have bought from one of the leading combines 90,000 tons of small coals for delivery at Lisbon and Oporto over the next few months.

Work at the Docks.

Some progress was made last week towards relieving the congestion at South Wales docks, and it was reported that on Wednesday of last week shipments came to over 100,000 tons. Still, the total for the whole week was not much over 300,000 tons, and on Saturday there were sixty-two steamers waiting to load, while on Monday that figure was increased, as the result of week-end arrivals, to sixty-six, while only two tips were idle. Most people interested in the export of coals felt last week that further steps were necessary to deal with the congestion, and that the arrangements made regarding the extra partial shift were inadequate. Consequently, the employing interests and the representatives of the G.W.R. Company and the trimmers and tippers had another conference on Friday afternoon last, when, subject to the approval of the workmen, it was decided to substitute the extra shift by an arrangement under which the men at Cardiff, Penarth, Barry, and Newport worked an extra two hours on the existing shifts, the men to receive 1s. 6d. per man per hour for the extra hours worked, this sum being paid by the shipowners in the case of the trimmers and by the G.W.R. Company in the case of the tippers. This new working arrangement is considered on all hands as far superior to the partial third shift, but, unfortunately, the trimmers at Newport, when they met on Sunday to consider what their representatives had done, declined to ratify it, and, in fact, on Monday they did not turn up at the docks to work according to the new hours, though the Newport tippers were ready at 6 a.m. in accordance with the new arrangement. Hopes are entertained that the trimming section will before the week is out fall into line, as the workmen, viz., trimmers and tippers, at Cardiff, Penarth, and Barry confirmed the new conditions. These extra two hours on each shift are to be operated until March 9th, but it does not apply to Port Talbot and Swansea, where there has not been anything like the congestion prevailing as at the other Channel ports.

LATER.

As the result of further negotiations the Newport coal trimmers have agreed with the employers to work overtime on the existing shifts as from Wednesday of this week, in the same way as that at present in operation at Cardiff, Penarth and Barry.

South Wales Shipping.

The annual report of the Cardiff and Bristol Channel Shipowners' Association for the past year has recently been issued, and in the course of the introduction it is stated that notwithstanding the difficult times experienced by the industry, further progress was made during 1928 in the development of the South Wales fleets. Tonnage launched amounted to approximately 200,000 tons deadweight, while orders for the construction of new vessels totalled about 226,000 tons deadweight. With few exceptions, the new vessels ordered were coal burning. The acquisition of this tonnage will raise the total shipping controlled by South Wales owners to nearly one and a half million gross tons.

Current Business.

A good inquiry continues to be received for most descriptions of coals, but most collieries are so fully booked up that they have practically no coals to offer. Best Admiralty large coals have been done at 20s. for small parcels and second qualities at 19s. to 19s. 6d. Small coals are also very firm; in fact, best sorts are almost unobtainable, and prices are nominally 13s. 9d. to 14s. Coke and patent fuel also display a good tone, but pitwood has ruled easy, owing to the difficulties of getting wagons into which to discharge supplies. Prices have been round about 25s. to 25s. 6d.

CONTRACTS.

THE WOODHALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., has received orders from the Tredegar Urban District Council Gas and Water Department for an installation of Woodall-Duckham continuous vertical retorts having a daily gas-making capacity of about 430,000 cubic feet, the plant to consist of six 53in. retorts. The order contract includes a new retort house, coke and coal-handling plant, waste heat boiler, &c. In addition, La Compagnie Générale de Construction de Fours has received an order to build an installation of Woodhall-Duckham continuous vertical retorts at Turin for the Società Torinese Industrie Gas E Electtricita. The plant is to have a carbonising capacity of 252 tons per day.

YARROW AND CO., Ltd., of Scotstoun, Glasgow, have received the following orders:—(*a*) From Brown and Adam, Ltd., Pollokshaws, Glasgow, for one boiler for 50,000 lb. per hour normal evaporation, fitted with mechanical stoker and arranged to work under balanced draught in conjunction with an air heater; (*b*) from the Indiarubber, Gutta Percha and Telegraph Works Company, Ltd., of Silvertown, for a complete boiler-house plant, including building, coal and ash-handling equipment, pipe work and valves, the boiler plant itself comprising three boilers, each for 40,000 lb. per hour normal evaporation; and (*c*) from the Harrogate Corporation for two boilers, each for 50,000 lb. per hour normal output, and including boiler-house, superheaters, economisers, and chain-grate stokers, fans, chimney, &c.

GREAT WESTERN RAILWAY COMPANY announces that the following contracts have been placed:—(*a*) Supply and erection of a cooking apparatus at Tregenna Castle Hotel, St. Ives, the Carron Company, Carron, Falkirk; (*b*) conversion of waiting room, No. 8 platform, Paddington Station, to tea room, A. E. Symes, Albert Works, Carpenter-road, Stratford, E. 15; (*c*) supply of horizontal milling machine for the locomotive works at Swindon, Alfred Herbert, Ltd., Coventry; (*d*) supply of a radial drilling machine, Wm. Asquith, Ltd., Halifax; (*e*) supply of two double axle lathes for the carriage and wagon department at Swindon, Craven Bros. (Manchester), Ltd., Vauxhall Works, Reddish, Stockport; (*f*) supply and delivery of steel girders and other steel and iron works, the Horsehay Company, Ltd., Horsehay, Wellington, Salop; (*g*) alteration to inquiry and receiving office, Torquay, Messrs. Stanley Jones and Co., 8, Gray's Inn-road, London; (*h*) supply and erection of a steel framed corrugated iron building for Frome Station, Fredk. Braby and Co., Ltd., Ashton Gate Works, Winterstoke-road, Bristol; (*i*) work to be done to premises, South Devon Chambers, Plymouth, Herbert T. Lapthorn, 20, William-street, Plymouth; (*j*) work to be done to warehouse at Chard, H. Bishop, Cillerhays Villas, Chard; (*k*) overhaul of s.s. "St. David," Cammell Laird and Co., Ltd., Birkenhead; (*l*) overhaul of steam tug "Archibald Hood," the Ocean Dry Docks Company, Ltd., Central Albion Dry Docks, Swansea; (*m*) overhaul of steam hopper barge No. 8, Thos. Diamond and Co., Ltd., Bute Docks, Cardiff; (*n*) supply and delivery of two electrically-driven ram pumps for Dinas, the Uskside Engineering Company, Ltd., Uskside Ironworks, Newport, Mon.; (*o*) supply and delivery of 6–30 cwt. warehouse cranes, Herbert Morris, Ltd., Loughborough; and (*p*) supply and delivery of four omnibus bodies and four six-cylinder chassis or 20-22 seater omnibuses, the Gilford Motor Company, Ltd., 465/471A, Holloway-road, N. 7.

CATALOGUES.

BUDA COMPANY, Cecil Chambers, Strand, W.C. 2.—Particulars of "Conneaut" metallic packing.

MARSHALL, SONS AND CO., Gainsborough.—Publication No. 1917 on type H heavy-oil engines.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Particulars of Stanton concrete products.

SIEMENS BROTHERS AND CO., Ltd., Woolwich, S.E. 18.—Pamphlet 155A dealing with super-tension cables.

HOLMAN BROTHERS, Camborne, Cornwall.—List No. 302/28, dealing with the Hele-Shaw Beacham air motor.

CAMPBELL AND ISHERWOOD, Ltd., Bootle, Lancs.—List E.P.T. 9, describing portable electric hand drills of all types.

RAWLPLUG COMPANY, Ltd., Rawlplug House, Cromwell-road, S.W. 7.—A leaflet describing a new bolt anchor for machinery.

COVENTRY VICTOR MOTOR COMPANY, Ltd., Coventry.—A folder introducing the firm's new outboard engine for motor boats.

SIMON-CARVES, Ltd., 20, Mount-street, Manchester.—A booklet dealing with the application of pulverised fuel firing to collieries.

R. AND J. DICK, Ltd., Greenhead Works, Glasgow.—Details of the "Dickbalata" element driving rope for industrial purposes.

J. DICKINSON AND CO. (Bolton), Ltd., Fairclough-street, Bolton.—Booklet on "Rock Asphalt and Related Specialities," as supplied by the firm.

BELLISS AND MORCOM, Ltd., Birmingham.—The third edition of the booklet "Combined Power and Heating," whereby the exhaust steam is utilised to heat buildings.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Booklet C.M. 6, "Measurement of Coal in connection with Mechanical Stokers by Means of the Lea Coal Meter."

THE GODFREY ENGINEERING COMPANY, Ltd., 18, Essex-street, W.C. 2.—Catalogue describing the "Godfrey" oxygen jet-cutting machine and the types of work for which it can be used.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., 136, Victoria-street, S.W. 1.—"The World Fuel Conference and the Gas Industry," by E. W. Smith, D.Sc., and T. Campbell Finlayson, M.Sc. A reprint from the *Gas Journal*.

TRAVELLING SCHOLARSHIPS.—The Chadwick Trustees invite applications for two travelling scholarships of £400 a year each, tenable for one year, to be awarded next July; one scholarship to be in sanitary science and the other in municipal engineering. The object of the scholarships is to enable the holders to travel abroad to study, either generally or in some particular aspect, the methods adopted in different countries for the prevention of disease and the improvement of public health, or the sanitary administration and engineering applied in urban or rural areas. Candidates must be British subjects, between twenty-five and thirty years of age, who have graduated in a British University or who can produce evidence of attainments or of intellectual equipment proving them to be capable of methodical study and research. Further particulars can be obtained from the Clerk of the Chadwick Trustees at 204, Abbey House, Westminster, S.W. 1.

A ROMANCE OF INDUSTRY.—A handsome brochure, excellently printed and illustrated, has just been published by Bolckow, Vaughan and Co., Ltd., and is devoted to the rise and development of that famous firm. It opens with a chapter on the two members of the original partnership of 1839, H. W. F. Bolckow, the son of a corn merchant in Mecklenburg; and John Vaughan, the son of an ironworks foreman, who had earned his living and learnt the business at Dowlais. It was one of those partnerships which are so frequently successful, Bolckow bringing the business training and the money and Vaughan the technical experience. The firm flourished for a time on wrought iron, but the real turning point in its progress was the discovery of Cleveland ore and the establishment of blast-furnaces. In later chapters the works are described by sections, not with much technical detail, but sufficiently to give the reader a good idea of the plant used in a huge steel works and with, here and there, interesting little scraps of history.

ELECTRIC SUPPLY IN AMERICA.—A construction budget for 1929 providing for the expenditure of £15,200,000 during the current year on new plant for its subsidiaries has been approved by the North American Company. To meet demand which, it is estimated, is increasing at the rate of 10 per cent. to 12 per cent. annually, extensions are to be made to the company's system in five of the most important areas in the United States. In the Mississippi district the capacity of the two chief plants will be increased by 67,000 kW, while additions of 35,000 kW each are to be made to the capacities of the Cleveland and Central Californian systems and 30,000 kW to the Washington system. In connection with plant additions, one subsidiary, the Milwaukee Electric Railway and Light Company, has just arranged a 10,000,000 dollars bond issue in New York through a group headed by Dillon Read and Co. During the years 1923–27 more than £41,200,000 was expended by the North American Company on plant construction. Gross earnings for the twelve months ended last September were £26,133,000, while output of electric power for the year ended in December has been estimated at approximately 6,000,000,000 kWh.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the informal meeting of the Institution of Electrical Engineers, held on Monday, February 18th, Mr. C. F. Mounsdon was in the chair, when Mr. R. L. Morrison opened a discussion on "Modern High-power Rectifiers, their Development and Use." Mr. Morrison said the optimism with which he had expressed of the future of this apparatus when he addressed a meeting on the subject a few years back, had been thoroughly justified, for they were being generally adopted throughout the world. Simultaneously they had increased in size. He attributed their progress chiefly to the seal of mercury which enabled a valve to be left for periods as long as six months without appreciable loss of vacuum. There was no foundation for the fear that mercury vapour poisoning was possible, for there was not a single instance on record. Mr. Morrison exhibited a number of slides showing rectifiers of various capacities, complete or in sections, and for different duties. He gave some remarkable figures of their effiiencies, especially on higher voltages, and he claimed that where conversion was required, the high power rectifier was unchallenged because it was stationary, silent and vibrationless; the maintenance was negligible and the service absolutely reliable. Mr. A. M. Browne said he preferred the glass bulb rectifier, which, though limited to some 130 kW capacity, could be multiplied indefinitely. It had the advantage that no pump was needed to maintain vacuum. Mr. T. F. Lister said the reason rectifiers had made more headway abroad than in England was because our conservatism liked to see something moving. Where the expense was justified it was possible to adopt 12-phase rectification and to eliminate all troubles of telephone and wireless interference. Messrs. R. Bienner-hassett, J. Eck, W. A. Erlebach, W. Lang, M. M. Macmaster, J. F. Shipley, S. A. Stevens, E. O. Taylor and H. H. Taylour also spoke.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/6 to 19/–
(1) Spanish	21/–
(1) N. African	21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 15 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 12 6	3 12 6
No. 1	3 13 0	3 13 0
Cleveland—		
No. 1	3 9 6	3 9 6
Silicious Iron	3 9 6	3 9 6
No. 3 G.M.B.	3 7 0	3 7 0
No. 4 Foundry	3 6 0	3 6 0
No. 4 Forge	3 5 6	3 5 6
Mottled	3 5 0	3 5 0
White	3 5 0	3 5 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 5 0	—
(3) Northampton—		
Foundry No. 3	2 17 6 to 2 19 0	—
Forge	2 13 0 to 2 15 0	—
(3) Derbyshire—		
No. 3 Foundry	3 2 6	—
Forge	2 17 6 to 2 18 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 2 6	—
No. 4 Forge	2 17 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (a); 4 3 0 (b); 4 8 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
LANCS.—		
Crown Bars	10 10 0	—
Second Quality Bars	10 0 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 8 17 6	—
Gas Tube Strip	10 12 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (continued).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 15 0	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
„ (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
„ (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	8 15 0 to 9 0 0	—
Hard Basic	8 15 0	—
Intermediate Basic	7 5 0 to 7 15 0	—
Soft Basic	7 0 0	—
Hoops	9 5 0 to 9 10 0	—
Soft Wire Rods	7 15 0 to 7 17 6	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 7 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	220 10 0
„ „ (three months)	222 0 0
Copper (cash)	79 13 9
„ (three months)	80 7 6
Spanish Lead (cash)	23 11 3
„ „ (three months)	23 12 6
Spelter (cash)	26 6 3
„ (three months)	26 5 0
MANCHESTER—	
Copper, Best Selected Ingots	84 10 0
„ Electrolytic	88 0 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	25 2 6
„ Foreign	23 15 0
Spelter	26 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/11 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/6
„ „ 6 p.c. to 8 p.c.	£20 12 6	7/–
„ „ 8 p.c. to 10 p.c.	£20 10 0	6/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£32 0 0	12/–
„ „ „ 1 p.c. carbon	£37 0 0	15/–
„ „ „ 0·70 p.c. carbon	£43 0 0	17/–
„ „ „ carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 6/– per unit	
„ Vanadium	13/9 per lb.	
„ Molybdenum	3/9 per lb.	
„ Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	10/– per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/6
„ „ Ell	18/6
„ „ Splint	18/6 to 19/6
„ „ Trebles	17/6
„ „ Doubles	16/–
„ „ Singles	14/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/6
„ „ Jewel	18/6
„ „ Trebles	17/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	17/– to 18/6
Screened Navigation	19/6
Trebles	17/6 to 18/6
Doubles	17/–
Singles	15/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	16/6
Secondary Steam	16/–
Trebles	17/6
Doubles	16/6
Singles	14/9

ENGLAND.

(8) N.W. COAST—	
Steams	23/–
Household	39/6 to 52/–
Coke	23/–
NORTHUMBERLAND—	
Best Steams	16/6
Second Steams	15/6 to 16/–
Steam Smalls	10/6 to 11/–
Unscreened	14/–
Household	21/– to 27/–
DURHAM—	
Best Gas	15/– to 15/3
Second	14/6 to 14/9
Household	21/– to 27/–
Foundry Coke	22/6 to 25/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	27/– to 28/6	—
Derbyshire Best Bright House	23/6 to 25/–	—
Best House Coal	21/– to 22/–	—
Screened House Coal	18/– to 19/–	—
„ „ Nuts	17/– to 19/–	—
Yorkshire Hards	15/6 to 16/6	—
Derbyshire Hards	15/6 to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/– to 7/–	—
Smalls	3/6 to 4/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		20/– to 21/–

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	19/9 to 20/–
Second Smokeless Large	19/– to 19/6
Best Dry Large	18/6 to 19/–
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/9 to 19/3
Western Valley Large	18/6 to 19/–
Best Eastern Valley Large	17/6 to 18/3
Ordinary Eastern Valley Large	17/– to 17/6
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/– to 13/–
Washed Nuts	18/– to 24/–
No. 3 Rhondda Large	20/6 to 21/6
„ „ Smalls	14/6 to 15/–
No. 2 „ Large	17/6 to 18/–
„ „ Through	16/– to 17/–
„ „ Smalls	12/6 to 13/6
Foundry Coke (export)	27/– to 37/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	25/9 to 29/3

SWANSEA—

Anthracite Coals:	
Best Big Vein Large	33/– to 35/–
Seconds	25/– to 29/–
Red Vein	22/– to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	36/– to 43/6
Beans	23/6 to 25/–
Peas	16/6 to 17/6
Breaker Duff	9/– to 9/6
Rubbly Culm	10/9 to 11/3
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	9/6 to 12/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

THE revival of industrial activity which began about three months ago is maintained, but there are factors in the situation that leave an undefined impression as to the future. The new law regarding workmen's insurance which is to come into operation in a few months, is looked upon with disfavour, and it is doubtful whether it can be applied in its present form. Then, the negotiations for the final settlement of German reparations may possibly affect the supply of material from that country upon which the carrying out of public works entirely depends. The labour problem is also serious, and so far as skilled labour is concerned, it appears almost insoluble. Costs, too, continue to rise, and that is affecting foreign trade. While there are plenty of elements of activity, the outlook is uncertain because there are factors of economic instability which will have to be dealt with before industry can settle down on a really satisfactory basis. One evidence of the greater activity is that, while the production of steel increased last year, the exports declined, thus showing that there was a larger home consumption. Prices all round are advancing, and in the case of rails there is some question as to what will happen when the renewal of the Rail Union will be discussed. British railmakers are insisting so strongly upon their claim to a monopoly of the trade in the Colonies and Dominions that there is at present a deadlock in the negotiations, and a committee is being appointed to find a way out of the difficulty. The time is so short that the prospects of a settlment being come to are very small indeed, and it is likely therefore that the Rail Union will be renewed provisionally on its present basis until the parties interested come to a final understanding.

The Steel Cartel.

All four members of the Steel Union exceeded their quotas of production last year, and while the progression was fairly constant, Germany alone showed a diminution during the last quarter. Nevertheless, the German excess production during the first quarter was so considerable that the net surplus for the year was 2,774,000 tons in a total of 14,515,000 tons. With a total of 9,387,000 tons France exceeded her quota by 255,000 tons. The Belgian production was 3,821,000 tons, with an excess of 438,000 tons, while the production of Luxemburg was 2,571,000 tons, or 139,000 tons in excess of the quota. In a general way, the members of the Cartel steadily increased their production, except Germany, whose output declined rapidly during the year, but as German steelmakers are involved in very heavy penalties, they continue to affirm that they will withdraw from the Cartel unless they are given a larger quota and unless the penalties are reduced. They argue that, as the increased production was due to home requirements, it does not effect the other members of the Union. Seeing that France, Belgium and Luxemburg have all exceeded their quotas it is believed that they are in favour of increased production, so that Germany may at least obtain partial satisfaction, and it is considered doubtful that German steelmakers will sacrifice the other advantages that accrue to them from the operations of the Cartel.

Barrages.

At the time of the disastrous failures of barrages in North Africa at the end of 1927, some sensation was caused by the declaration of a well-known authority to the effect that similar accidents might happen to almost any of the barrages in France. Their design, he affirmed, was based upon faulty formulæ, and, in his opinion, safety could only be provided by barrages of the vaulted type. The others would require so much material as to render their construction too expensive. Although the Association des Entrepreneurs des Grands Barrages protested against this condemnation of existing barrages by declaring that their design was based upon the experience gained in the United States and other countries, it is certain that preference is now being shown for the vaulted type, which it is proposed to adopt for the new barrages to be constructed in Algeria and Morocco. It is declared that, for a given margin of safety, they allow of an economy of as much as 75 per cent. in the quantity of concrete employed. There are only two small barrages of this type in France, one on the Sélune and the other on the Léguer near Belle-Isle-en-Terre in Brittany. The latter barrage crosses the narrowest part of the Léguer Valley and provides a head of 13·5 m. It has fifteen triangular-section reinforced concrete springers supporting vaults inclined at 45 deg. and thrusting on a reinforced concrete foundation resting on the granite bed of the river. The horizontal section of the vaults is semi-circular The necessity of settling upon some definite and more practical data, and thereby avoiding disasters such as have happened in the past, is now so fully recognised that La Commission Internationale des Grands Barrages was created six months ago in order to provide an interchange of ideas amongst different countries and collect data of all kinds concerning barrage design and construction. The Executive Committee of the Commission held its first meeting in Paris last week under the Presidency of the Minister of Public Works.

Colliery Industry.

Those colliery companies which publish balance sheets are showing results that are by no means unsatisfactory. There is no doubt that their situation was precarious at times during the past year, and they were able to point to huge accumulations of stocks to justify their appeals to Government for assistance in the way of obtaining special freights to enable them to dispose of their fuel on the Channel and Atlantic seaboards in competition with British coal. If they have, on the whole, emerged successfully from a difficult situation it is due mainly to the remarkably good organisation of the industry.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

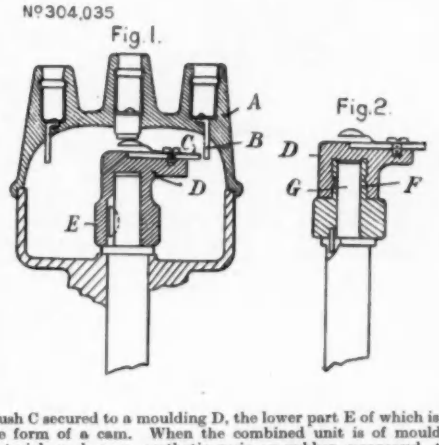
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

304,035. January 25th, 1928.—IMPROVEMENTS IN AND RELATING TO IGNITION DEVICES FOR INTERNAL COMBUSTION ENGINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Cecil James Morton, of "Amulree," St. Paul's-road, Coventry; and Leslie Mandell Thomas Bell, of 51, Walsgrave-road, Coventry.

The object of this invention is to simplify and cheapen the construction of high-tension distributors and to facilitate accurate assembly of the parts. A is the cover of a chamber, containing a combined interrupter and distributor, provided with fixed electrodes B co-operating with the rotating electrode or

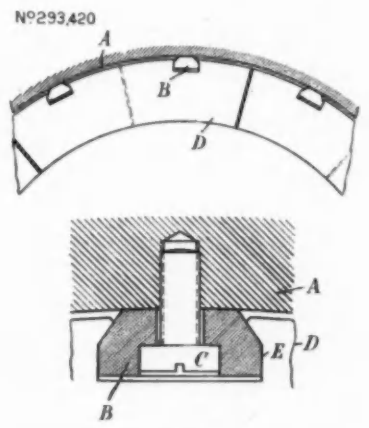


brush C secured to a moulding D, the lower part E of which is in the form of a cam. When the combined unit is of moulded material, such as a synthetic resin or rubber compound, the relative positions of the electrode C and cam E are taken care of when shaping the mould and the finished unit can be keyed or splined on the spindle as shown. As an alternative the cam E may be made of metal, as shown in Fig. 2, and provided with an integral sleeve F bored to fit the spindle G. The brush holder may then be moulded around this sleeve and the combined unit secured to the spindle in any convenient manner.—*January 17th*, 1929.

DYNAMOS AND MOTORS.

293,420. June 26th, 1928.—AN IMPROVED LAMINATED CORE BODY FOR ELECTRIC MACHINES AND APPARATUS, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.*

It has hitherto been customary to arrange the individual core plates, of which core bodies of electrical machines and apparatus are built up, in a rigid fashion. This has presented that disadvantage that, when the core plates were heated, stresses due to that heating occurred. According to this invention, this

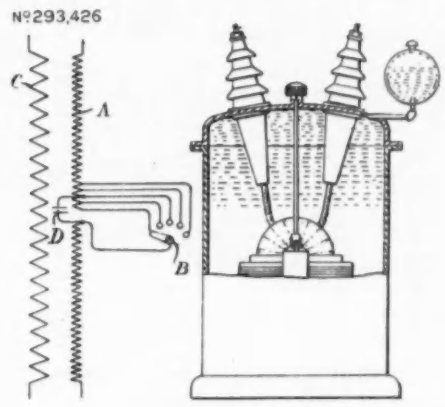


defect is obviated by arranging the core plates on ribs having a radial play, but being rigidly fixed in the tangential direction. In the stator frame A the bars or ribs B are fixed by means of the screws C. The individual core plates D are assembled on the ribs B with radial play. The cross section of the ribs B is substantially trapezoidal in shape or in the form of an irregular hexagon, as shown in the drawing, with lateral straight shoulders or bosses E which take up the lateral pressure of the core plates and which prevent a tangential displacement while permitting a radial displacement.—*January 17th*, 1929.

TRANSFORMERS AND CONVERTERS.

293,426. July 5th, 1928.—IMPROVEMENTS IN AND RELATING TO VARIABLE RADIO TRANSFORMERS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

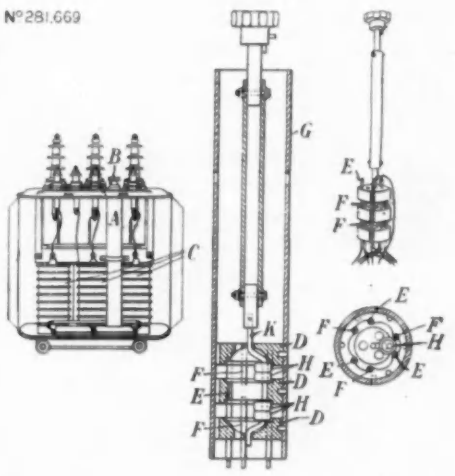
The transformer shown is enclosed in a casing containing a body of insulating oil in which the transformer is immersed. The insulating oil extends to the level in an expansion chamber to permit expansion and contraction of the oil as its temperature changes. The leads from the secondary winding are carried out of the casing through bushings to terminals for connection to an outside circuit. This secondary winding A is provided with taps connected to a tap switch B by means of which the ratio of voltage transformation of the transformer may be varied or adjusted as desired. The taps, which are at one side of a break in the secondary circuit are connected to the stationary contacts of the switch B, the movable contact of the switch being connected to the secondary circuit at the other side of the break. Thus the groups of winding turns between the taps may be made effective or ineffective by cutting them into or out of circuit in steps corresponding to the number and distribution of the taps. It has been found that the capacitance of the secondary winding and the capacitance between the leads and the bushings which surround and insulate them where they pass out through the casing are sufficient to permit an appreciable charging current in the secondary winding when the transformer is excited by current in the primary winding C even though no load circuit is connected through the terminals to the secondary winding. This is particularly true if the voltage of the secondary



winding is high. By-passes such as high resistances or low-capacity condensers have been proposed and used across switch contacts to reduce or prevent arcing or sparking at the contacts when the switches are opened or closed. A transformer tap switch is generally a multi-contact switch, however, and would require several such by-passes to protect all its contacts. The present invention provides such protection with a single by-pass, shown as a condenser D. The condenser is of small capacity and is connected across the break in the secondary circuit, one terminal of the condenser being connected to the tapped portion of the winding and the other terminal being connected to the secondary circuit at the other side of the break therein. When the switch B is operated to change the voltage ratio of the transformer, any arcing or sparking at the switch contacts as they are opened or closed will be negligible because of the shunt path provided by the condenser through which any discharge of current may easily take place.—*January 17th*, 1929.

281,669. November 30th, 1927.—SWITCHES FOR ADJUSTING RATIOS OF TRANSFORMERS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The transformer tapping switch is shown at A with a handle B which serves to regulate the voltage of the transformer, the windings C of which have to be connected in such a manner as to obtain the desired ratio of transformation. The top charging apparatus has a number of rings D of insulating material supporting contact pieces E and F. The stationary contact pieces are constituted by sets of metal rods or tubes arranged parallel to and at an equal distance from the axis of the tube G. The sets of rods are connected to different sections of the windings, preferably of the high-tension windings, of the transformer. In



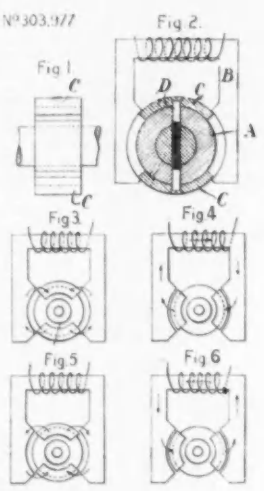
polyphase transformers mounted in star in each position of the switch there are arranged in two adjacent parallel lines as many stationary contact pieces as there are phases. There would obviously be as many positions of the switch as there may be different ratios of transformation to be obtained. The two lines of stationary contacts E and F are connected by a movable contact H. The contact H is mounted upon an excentric portion of a rotatable conducting shaft K concentrically mounted within the tube. In order to vary the ratio of transformation the handle B is turned, which displaces the contacts H to connect a fresh set of contacts E F. This operation is carried out when the transformer is not receiving current from the line.—*January 31st*, 1929.

ELECTRICAL APPLIANCES.

303,977. November 29th, 1927.—IMPROVEMENTS IN OR RELATING TO MAGNETO-ELECTRIC MACHINES, Emile Morel, of 223, Boulevard Pereire, Paris.

The magneto inducing device according to the invention comprises a magnet A, as shown in Figs. 1 and 2, and an armature B. The magnet comprises two pole pieces or caps C of iron or soft steel which have diametrically opposite positions and extend about a quarter of the periphery, so as to fix the north and south polarities. Each of the pole pieces is secured in place by a screw D of non-magnetic metal which traverses the magnet and is screwed to the shaft when the magnet is fitted in place. Figs. 3 to 6 show four positions of the inducing system in order

to illustrate the operation of the machine. At each revolution of the shaft the flux in the armature will be annulled twice—

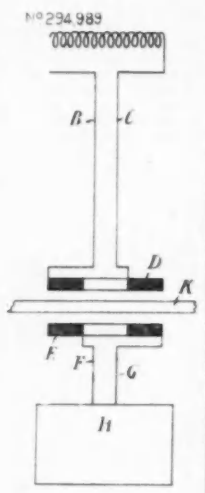


Figs. 3 and 5—and it becomes a maximum either in one direction—Fig. 4—or in the other—Fig. 6.—*January 17th*, 1929.

TELEGRAPHS AND TELEPHONES.

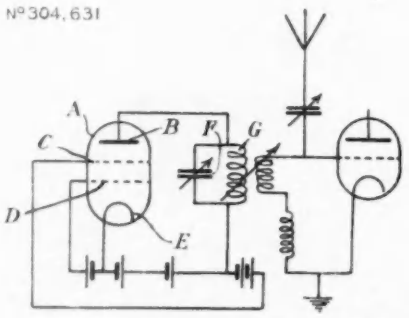
294,989. August 2nd, 1928.—Improvements in or relating to Coupling Devices, Suitable for use with Rotatable Frame Aerials and the like, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

This invention relates to coupling devices, and more particularly to coupling devices for use with rotatable frame aerials. A rotatable directional frame aerial, is connected by means of conductors B and C to a winding D arranged to rotate with the frame. Adjacent the winding D is a fixed winding E, which is connected by means of conductors F and G to a direction-finding receiver or other device H. The windings D E thus constitute the primary and secondary respectively of a transformer. As shown, the windings D and E are flat coils, but they may, of course, be of cylindrical or any other shape, provided that the coupling is not altered by relative rotation. It will be seen that the above construction provides a coupling device which is very simple and reliable, and in which electrical resistances and other essential factors remain substantially constant independent of the rotation of the frame. A well-insulated plate K is inserted between the coils D and E. The invention may, it is claimed, be advantageously applied to submarine direction apparatus, by mounting the primary coil D and the frame with which it rotates outside the water-tight hull of the boat, only the stationary coil E being inside.—*January 10th*, 1929.



304,631. October 20th, 1927.—Thermionic Valve Negative Resistance Devices and the like, Willoughby Statham Smith, of "Benchams," Newton Poppleford, Devonshire; and Norman William McLachlan, of 18, Wharf-road, London, N. 1.

This invention relates to thermionic valve negative resistance devices and the like, and more particularly to negative resistance devices for reducing the damping of oscillatory circuits, such as

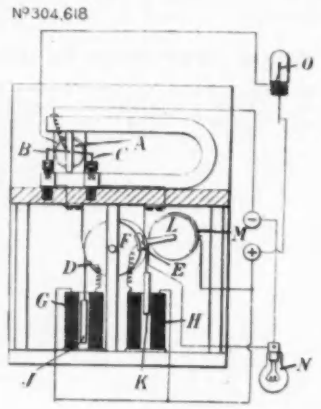


those employed in telegraph and telephone apparatus, radio receivers, &c. A negative resistance device employed in accordance with this invention for reducing damping comprises a screened valve A provided with an anode B, screening grid C, control grid D, and cathode E. In the anode circuit of the valve is an oscillatory circuit comprising a capacity F and inductance G, the latter being variably coupled to the circuit, the damping of which is to be reduced and which may be, for example, a radio aerial circuit as shown or a rejector circuit.—*January 21st*, 1929.

MISCELLANEOUS.

304,618. October 14th, 1927.—Means for Closing a Local Circuit by Variations in an Applied Electrical Current, John Neale, of 15, Acacia-road, St. John's Wood, London, N.W. 8.

This invention relates to improved means for closing a local circuit by variations in an applied electrical current, and is of special application to the case where a mercury contact relay or any circuit-closing or breaking device having light or delicate contacts is employed. A is the relay of moving coil type with contacts B C and mercury cups through which electrical connection can be made with metal segments D E respectively on the throw-over switch F. The segments D E are electrically connected with the solenoids G H, the cores J K of which are carried by the drum F of the throw-over switch. On the same spindle as the drum F is the drum L carrying a contact segment M for making and breaking the main local circuit containing—as shown in the drawing by way of example—the lamp N. The relay main circuit includes, as shown by way of example, a light-sensitive bridge O, the change in resistance of which due to light change causes the actuation of the relay A. The connections shown are suitable for automatic street lighting or other



lighting and many other commercial purposes. Amongst these may be mentioned the adjustment for temperature variation in high-temperature furnaces, the light-sensitive bridge being operated by the rays from the incandescent material in the furnace. The action of the device is obvious. The drawing shows the segment E connected with the relay contact C, the core K being raised out of the solenoid H. The closing of the contact C energises the solenoid H, pulling down the core K and thus rotating the throw-over switch and closing the main local circuit, which is shown as including the lamp N. At the same time the relay local circuit is broken, but the segment D now makes contact ready for the return of the relay coil and thus the apparatus is reset.—*January 14th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Automobile Engineers: Graduates' Meeting.—Regent Restaurant, 51, West Regent-street, Glasgow. "Inspection," by Mr. E. C. Philbrow. 8 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Meter and Instrument Section meeting. Paper, "The Rotor Bearings of Electricity Meters," by Mr. W. Lawson. 7 p.m.

Institution of Locomotive Engineers.—Frascati Restaurant, London. Annual dinner. 7 p.m.

Joint Delegation of the Local (Yorkshire) Associations of the Institutions of Civil, Mechanical, Electrical, Municipal and County, Locomotive and Structural Engineers.—Great Northern Hotel, Leeds. Fourth Joint Delegation dinner. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecture, "Notes on the Control of Electric Lifts," by Mr. L. S. Atkinson. 7.30 p.m.

Keighley Association of Engineers.—Kiosk Café, Keighley. Joint meeting with the Keighley Textile Society. Lecture, "The Geared Turbine and its Application to Textile Mills," by Mr. H. N. Nutter. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Infra-red Spectra," by Sir R. Robertson, F.R.S. 9 p.m.

SATURDAY, MARCH 2nd.

Belfast Association of Engineers.—Thompson's Restaurant, Belfast. Annual dinner. 6.45 p.m.

London Association of Foremen Engineers.—Cannon-street Hotel, London, E.C. 4. Seventy-sixth anniversary festival. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Molecular Motions in Rarefied Gases," by Sir Ernest Rutherford, F.R.S. 3 p.m.

MONDAY, MARCH 4th.

Institution of Automobile Engineers: Graduates' Meeting.—The College, Loughborough. "Lubrication," by Mr. G. L. B. Hall. 7 p.m.

Institution of Automobile Engineers: Western Centre.—Merchant Venturers' Technical College, Bristol. "Air-cooled Engine Repairs and Lay-out," by Mr. A. H. R. Fedden. 6.45 p.m.

Railway Club.—57, Fetter-lane, London, E.C. 4. Paper, "Crime and the Iron Road," by Mr. G. S. Walker. 7.30 p.m.

Royal Aeronautical Society.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "The Royal Air Force Far East Flight," by Group-Captain H. M. Cave-Browne-Cave. 6.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General Meeting. 5 p.m.

Society of Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Waterproofing of Concrete Structures," by Mr. H. R. Lordly. 6 p.m.

Surveyors' Institution.—12, Great George-street, Westminster London, S.W. 1. Paper, "Recent Developments in Town Planning," by Mr. F. Longstreth Thompson. 8 p.m.

TUESDAY, MARCH 5th.

Institution of Automobile Engineers: General Meeting.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "The Heavy Oil Engine on Road and Rail," by Mr. A. E. L. Chorlton. 7.45 p.m.

Institution of Automobile Engineers: Graduates Meeting.—Broadgate Café, Coventry. "Pistons," by Mr W. S. Ascough. 7.15 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Paper, "Impact in Railway Bridges, with Particular Reference to the Report of the Bridge Stress Committee," by Mr. Conrad Gribble. 6 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Some Aspects of the Wire-Drawing Process," by Dr. F. C. Thompson. 7.30 p.m.

WEDNESDAY, MARCH 6th.

Institution of Civil Engineers: Yorkshire Association.—Grand Hotel, Leopold-street, Sheffield. Lecture, "Development of the Generation and Distribution of Electrical Power in the British Isles," by Mr. Archibald Page. 7.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "Single Wave Length Working," by Captain P. P. Eckersley and Mr. A. B. Howe. 6 p.m.

Institution of Heating and Ventilating Engineers.—Caxton Hall, Westminster, London, S.W. 1. Lecture, "The Dessication of Vegetable Material," by Dr. B. J. Owen. 7 p.m.

Newcomen Society.—Demonstration Room, Ground Floor, Science Museum, South Kensington, London, S.W. 7. Paper, "A Comparison between French and English Windmills," by Mr. H. O. Clark. 5.30 p.m.

Wolverhampton and District Engineering Society.—Star and Garter Hotel, Wolverhampton. "Electricity Meters," by Mr. G. H. Sammons. 7.30 p.m.

THURSDAY, MARCH 7th.

Institute of Metals: London Local Section.—Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W. 1. "Theory, Practice and Nickel," by Mr. W. T. Griffiths. 7.30 p.m.

FRIDAY, MARCH 8th.

Institute of Metals: Sheffield Local Section.—Non-Ferrous Section of the Applied Science Department, The University, St. George's-square, Sheffield. "Progress in Electric Furnaces," by Messrs. D. F. Campbell and W. S. Gifford. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Chairman's address, "Road Transport," by Mr. S. H. Hole. 7.30 p.m.

Keighley Association of Engineers.—Room 14, Temperance Institute, Keighley. Lecture, "Centrifugal Castings," by Mr. H. G. Springfield. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "The Place of Women in Later Mediæval Civilisation," by Professor T. F. Tout. 9 p.m.

SATURDAY, MARCH 9th.

Institution of Municipal and County Engineers.—Town Hall, Sheffield. Yorkshire District Meeting. Paper, "The Local Government Act and the Municipal Engineer," by Mr. W. J. Hadfield. 1 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Molecular Motions in Rarefied Gases," by Sir Ernest Rutherford, F.R.S. 3 p.m.

MONDAY, MARCH 11th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Open discussion. 7.30 p.m.

Institution of Automobile Engineers.—Queen's Hotel, Birmingham. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7 p.m.

TUESDAY, MARCH 12th.

Institution of Automobile Engineers: London Graduates.—At Watergate House, Adelphi, W.C. 2. "Metal Omnibus and Car Bodywork," by Mr. D. Swallow. 7.25 p.m.

Institution of Automobile Engineers.—Rover Sports Club, Albany-road, Coventry. General meeting. 7.30 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, Leeds. Annual dinner. 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "Pulverised Fuel To-day," by Engineer-Captain J. C. Brand. 7.30 p.m.

WEDNESDAY AND THURSDAY, MARCH 13th and 14th.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Twenty-first annual general meeting. For programme see page 130. 10 a.m. each day.

TUESDAY, MARCH 19th.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. "Aluminium." by Dr. N. F. Budgen. 7 p.m.

Institute of Metals: North-East Coast Local Section.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Annual General Meeting and Exhibition of Metallurgical Preparations and Products. 7.30 p.m.

FRIDAY, MARCH 22nd.

Institution of Locomotive Engineers: North-Eastern Centre.—Hotel Metropole, Leeds. "Experiments on Buffer Springs," by Mr. T. Robson. 7 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. A. Dunbar, of the Elswick works of Vickers-Armstrongs, Ltd., has been appointed a special director of that works.

Bean Cars, Ltd., asks us to announce that it has recently appointed as its managing director Mr. Noel Martin, who joined it as director of sales and export six months ago.

Engineering Golfing Society.—The twentieth annual general meeting of the Engineering Golfing Society was held, by permission of the Council of the Institution of Mechanical Engineers, in the Institution building, on Tuesday, February 26th, Mr. E. W. Timmis, Vice-President, in the chair. Office bearers for the current year were elected as follows:—President, Sir Robert A. Hadfield; Vice-Presidents, D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, W. H. Shortt, E. W. Timmis, K. A. Wolfe-Barry, W. L. Mansergh; Captain, R. J. M. Inglis; Honorary Secretary and Treasurer, H. P. Allison; and Honorary Auditor, S. C. Lewis. The following were elected members of Committee:—B. Hall Blyth, P. B. Brown, H. P. Gaze, H. G. Hale, W. R. Manning, C. W. Myddleton, D. T. Powell, P. L. Riviere, H. C. Siddeley.